EMCSF 25.2 V14
EMRRR 25.2 V1

Phase IV Ponds Closure Plan

Volume 1

FMC Idaho, LLC
Pocatello, Idaho

August 1998
Revised May 2002

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1 Executive Summary

Executive Summary

FMC Idaho, LLC (FMC), formerly Astaris Idaho, LLC (Astaris), owns and is decommissioning its former elemental phosphorus production plant in southeast Idaho, located approximately 3 miles west of Pocatello, in Power County. The facility ceased producing elemental phosphorus from phosphate ore in December 2001 and is currently being decommissioned by FMC.

The FMC EPA Facility Identification Number is IDD 070929518. The plant operation included waste management units (WMUs) which have interim status under the Resource Conservation and Recovery Act (RCRA). The Phossy Water Clarifier Pond System (Ponds 11S, 12S, 13S, and 14S), referred to as the Phase IV Ponds and designated as WMU #8, comprised one of the units included in the February 21, 1991 amendment to FMC's Part A application, and in the RCRA *Part B Permit Application* (FMC 1991) that FMC submitted to EPA Region 10 on March 1, 1991.

A closure plan was later submitted to EPA, which was planned to be implemented when the ponds were no longer required for the management of phossy water (FMC 1994b). In a letter dated January 23, 1997, EPA requested that FMC submit a revised Phase IV Ponds Closure Plan to the Agency. A revised Phase IV Ponds Closure Plan was prepared in response to that request and submitted to EPA with the December 3, 1997 FMC facility Part B permit application revision (FMC 1997). This document is the closure plan for the final closure of the Phase IV ponds in accordance with the RCRA requirements specified in 40 C.F.R. Part 265.

This closure plan has been revised to incorporate the responses to EPA comments that were submitted to EPA on April 12, 1999, the initial fill and temporary cap construction activities conducted in 1999, settlement monitoring since 1999, and updated technical specifications, final design considerations, final cap construction drawings and plant closure. This current revision of the Phase IV closure plan also makes the Phase IV cap design consistent with the EPA-approved cap constructed over Pond 8S (WMU #7).

Constructed in 1980, the Phase IV ponds cover an area of 8.9 acres, and have a combined design capacity of 94 acre-feet. The ponds are single-lined with 30-mil polyvinyl chloride. Groundwater under the unit is monitored for releases by five RCRA groundwater monitoring wells, consisting of one upgradient and four downgradient wells. As detailed in Astaris' *RCRA Interim Status 2000 Groundwater Monitoring Assessment* report (Astaris 2001a), there is no evidence that the unit is leaking.

The Phase IV ponds were used for clarifying phossy water from various sources, for reuse in plant operations. "Phossy water" is any water in the process that has come in contact with elemental phosphorous. Primary clarification occurred in Ponds 11S, 12S and 13S, while Pond 14S functioned as a surge pond for the clean, recyclable industrial clarified water (ICW). To maintain capacity, Ponds 11S, 12S and 13S were periodically dredged during their operation.

FMC dredged the solids from the Phase IV ponds to the extent practicable and placed the solids initially into Pond 15S (until August 31, 1993, when Pond 15S, designated WMU #3, ceased operations), and later in Pond 16S (WMU #10). The Phase IV ponds continued in operation for the receipt and storage of nonhazardous (with respect to cadmium concentration) phossy water until closure activities were initiated at the start of the 1999 construction season.

FMC proposes closing the ponds with waste in place in accordance with 40 C.F.R. §265.228(a)(2). A cap design similar to that proposed for Pond 8S (WMU #8) (FMC 1998a) is proposed for the Phase IV ponds. Closure with waste in place requires placement of backfill in a controlled manner on top of the pond solids to provide a stable subgrade for placing the proposed RCRA cap. The initial backfill was placed in thin uniform layers over the pond solids and a temporary cover was installed over the completed initial backfill to minimize precipitation infiltration into the fill. The initial fill and temporary cover for the Phase IV ponds was completed on October 19, 1999.

A settling period is required after backfilling and before the final RCRA cap is installed. The settling period is necessary due to the anticipated consolidation of the pond solids under the weight of the backfill. The duration of the settlement period will depend on the rate of settlement, which will be monitored and reported to the EPA on a periodic basis.

The liquid wastes anticipated during closure are from dewatering activities and from equipment decontamination. Water from dewatering activities was sent to an onsite RCRA MTR surface impoundment prior to the December 31, 2001 expiration of the LDR case-by-case extension. After January 1, 2002 any liquid wastes will be sent to a new on-site water treatment plant or otherwise managed in accordance with RCRA requirements. Construction debris and wastes that are not hazardous may be disposed of in the on-site solid waste landfill or an off-site solid waste landfill.

Since the Phase IV ponds will be closed with waste in place, this plan also incorporates a Post-Closure Plan. Post-closure activities for the Phase IV ponds will include inspections, maintenance, and continuation of FMC's ongoing RCRA Groundwater Monitoring Program. In addition, FMC will continue to monitor any settlement of the final RCRA cap during the post-closure period.

A detailed schedule and cost estimate for the closure and post-closure activities are presented in this closure plan. Due to the nature of this recommended type of closure, construction activities will, of necessity, take longer than the regulatory time for closure of 180 days. This Phase IV Closure Plan serves as a request for EPA approval of an extended closure period for the Phase IV ponds, in accordance with 40 C.F.R. §265.113(b)(1)(i).

The closure activities will be documented and certified by a Professional Engineer registered in the State of Idaho. After completion of the closure activities, FMC will submit a closure certification report to EPA Region 10.

Introduction

2.1 FACILITY DESCRIPTION

FMC Idaho, LLC (FMC), formerly Astaris Idaho, LLC (Astaris), owns and is decommissioning its former elemental phosphorus production plant in southeast Idaho, located in Power County, approximately 3 miles west of Pocatello (Figure 2-1). The facility ceased producing elemental phosphorus from phosphate ore in December 2001 and is currently being decommissioned by FMC.

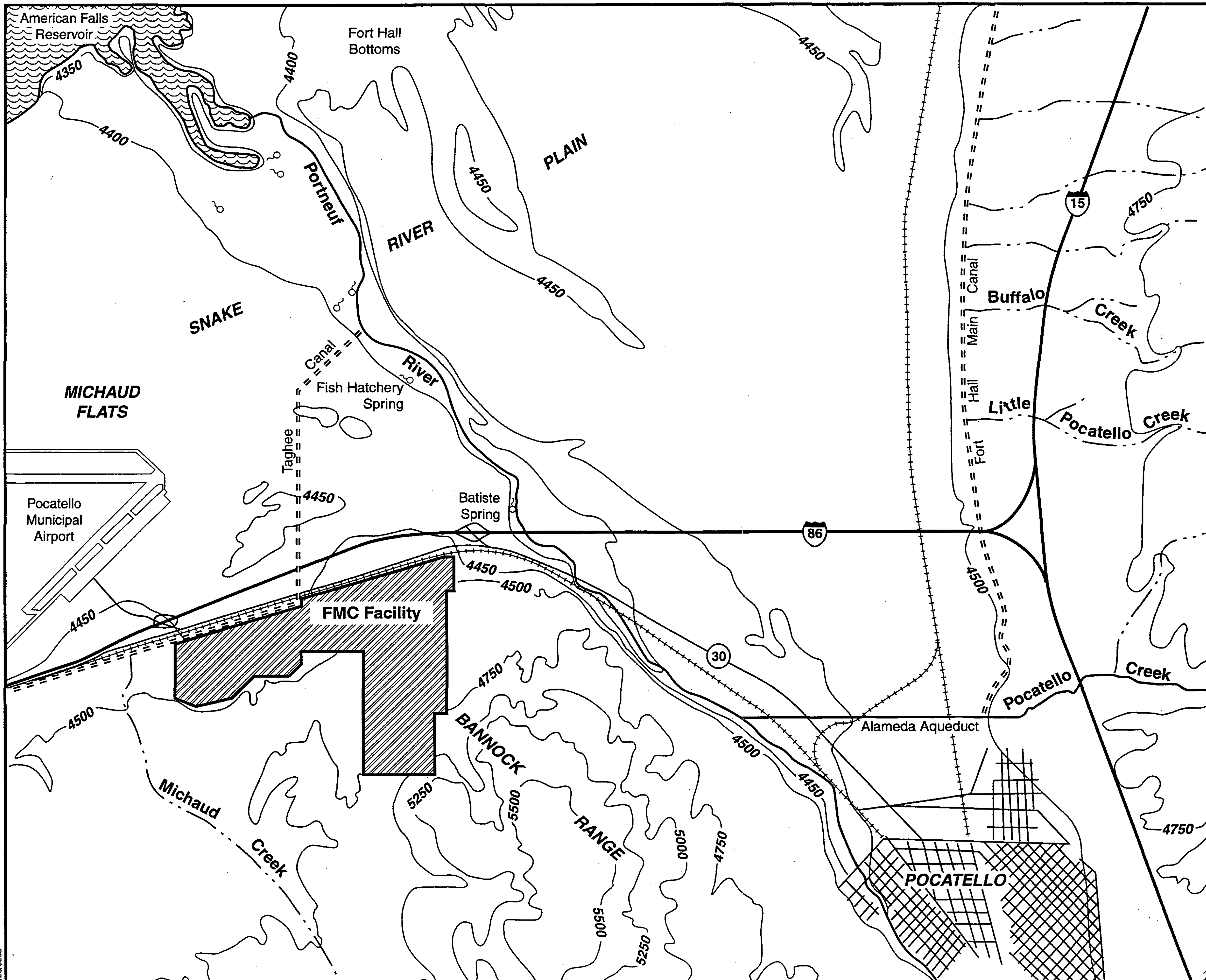
The FMC EPA Facility Identification Number is IDD 070929518. In operation since 1949, the FMC plant is located geographically within a Superfund site known as the Eastern Michaud Flats (EMF) site, which was placed on the National Priorities List (NPL) on August 30, 1990. A remedial investigation/feasibility study (RI/FS) was initiated in 1992, and has been completed at the EMF site (Bechtel 1996, and Bechtel 1997). EPA issued a ROD for the site in June 1998.

The FMC facility first became subject to the Resource Conservation and Recovery Act (RCRA) Subtitle C permitting regulations in March 1990 due to the removal of the Bevill Exemption from certain mineral processing wastes. The plant operation included waste management units (WMUs) that have interim status under RCRA. The Phossy Water Clarifier Pond System (Ponds 11S, 12S, 13S, and 14S), termed the Phase IV Ponds and designated as WMU #8, was included in the February 21, 1991, amendment to FMC's Part A application and in the *RCRA Part B Permit Application* submitted to EPA Region 10 on March 1, 1991 (FMC 1991). The location of the unit is shown in Figure 2-2. The Phase IV ponds were constructed in 1980 primarily to recycle phossy water through clarification, while providing evaporative surface area.

The Phase IV ponds cover an approximate area of 8.9 acres and have a combined design capacity of 94 acre-feet. The ponds are single-lined, and were originally provided with a leachate detection system. The leachate detection system is nonfunctional. Groundwater beneath the Phase IV ponds is monitored with a RCRA groundwater monitoring system that for this unit consists of one upgradient and four downgradient wells.

2.2 CLOSURE PLAN BACKGROUND

FMC first submitted a Phase IV Ponds Closure Plan to EPA on March 1, 1991, as part of the company's *RCRA Part B Permit Application* for the Pocatello facility (FMC 1991). FMC submitted a substantially revised Phase IV Ponds Closure Plan to EPA on November 3, 1994, (FMC 1994b).



LEGEND

- River
- Intermittent Stream
- Spring
- 4500 Topographic Contour
- Union Pacific Railroad
- Canal

NOTES:

1) Contour Intervals:
   Above 4500 ft. elevation: 250 ft.
   Below 4500 ft. elevation: 50 ft.

2) Base map adapted from Trimble, 1976, and from USGS Michaud (1971) and Pocatello North (1971) 7.5 minute topographic quadrangles.

N

0 1 2
Approximate Scale in Miles

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
FMC Facility Location		
Job Number	Drawing No.	Rev.
24230	Figure 2-1	1

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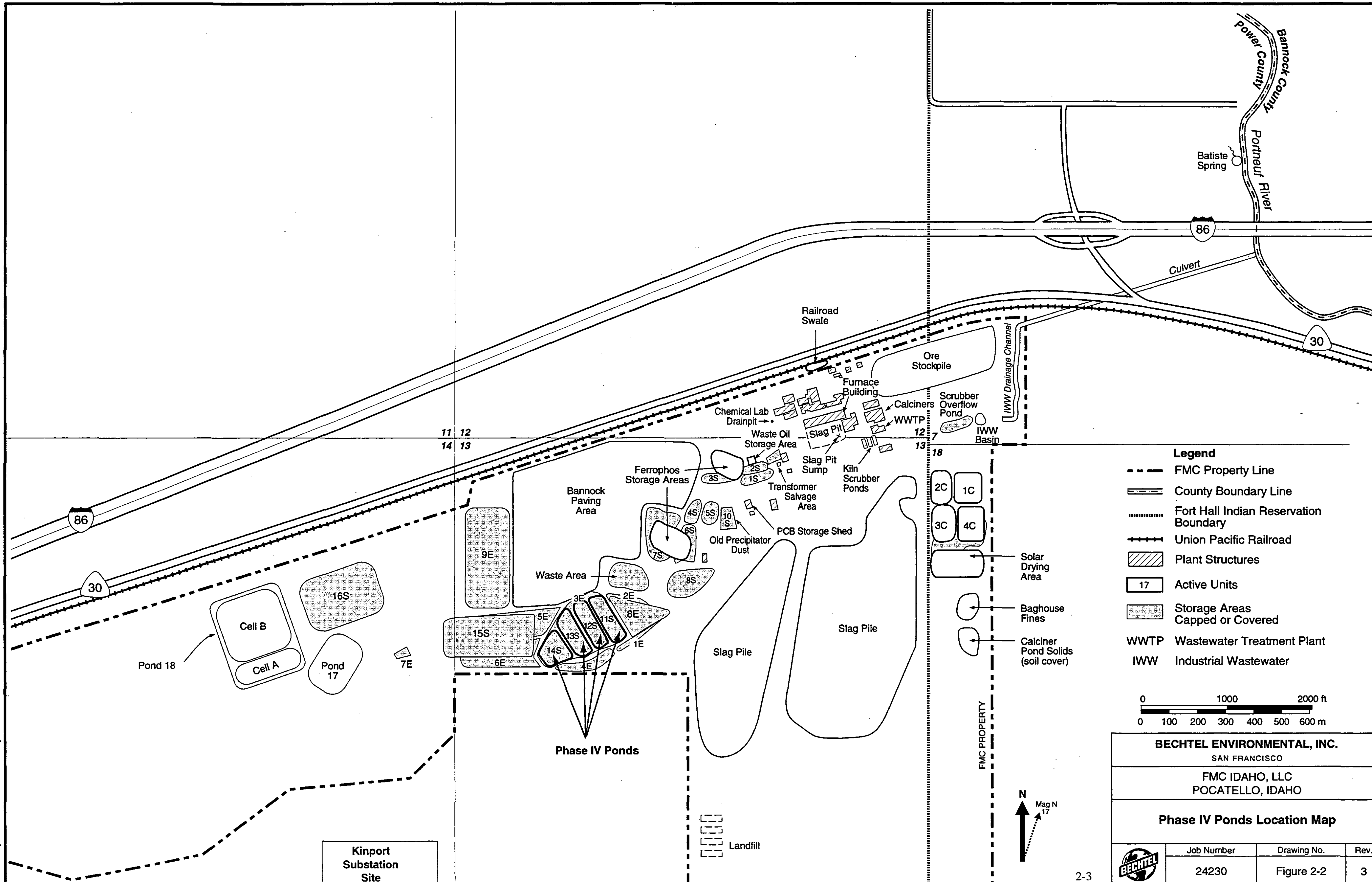


Power County
Bannock County
Portneuf River
Batiste Spring
86
Culvert
30
Railroad Swale
Ore Stockpile
IWW Drainage Channel
Furnace Building
Chemical Lab Drainpit
Calciners
Scrubber Overflow Pond
WWTP
Slag Pit
Waste Oil Storage Area
IWW Basin
11 12
14 13
12 7
13 18
Slag Pit Sump
Kiln Scrubber Ponds
Ferrophos Storage Areas
Transformer Salvage Area
Bannock Paving Area
3S
2S
1S
4S
5S
10 S
6S
7S
8S
Old Precipitator Dust
PCB Storage Shed
9E
Waste Area
16S
Cell B
Cell A
Pond 18
Pond 17
7E
15S
5E
3E
2E
8E
12S
11S
13S
14S
1E
6E
4E
Phase IV Ponds
Slag Pile
Slag Pile
2C
1C
3C
4C
Solar Drying Area
Baghouse Fines
Calciner Pond Solids (soil cover)
FMC PROPERTY
Landfill
Kinport Substation Site
N
Mag N 17°
Legend
FMC Property Line
County Boundary Line
Fort Hall Indian Reservation Boundary
Union Pacific Railroad
Plant Structures
17 Active Units
Storage Areas Capped or Covered
WWTP Wastewater Treatment Plant
IWW Industrial Wastewater
0 1000 2000 ft
0 100 200 300 400 500 600 m
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC IDAHO, LLC
POCATELLO, IDAHO
Phase IV Ponds Location Map
Job Number 24230
Drawing No. Figure 2-2
Rev. 3

In a letter from EPA Region 10 to FMC dated January 23, 1997, EPA requested FMC to submit a revised, more detailed, closure plan for the Phase IV ponds, which would provide the basis for closure of the unit after the plan had been approved by the EPA. A revised Phase IV Ponds Closure Plan was prepared in response to that request and submitted to EPA with the December 3, 1997 FMC facility Part B permit application revision (FMC 1997b). The Phase IV closure plan submitted August 1998 incorporates changes primarily associated with final cap design and makes the Phase IV cap design consistent with the EPA-approved cap constructed over Pond 8S (WMU #7). This closure plan has been revised to incorporate the responses to EPA comments that were submitted to EPA on April 12, 1999, the initial fill and temporary cap construction activities conducted in 1999, settlement monitoring activities since 1999, and updated technical specifications, final design considerations, final cap construction drawings, and plant closure. This document is the closure plan for the final closure of the Phase IV ponds in accordance with the RCRA requirements specified in 40 C.F.R. Part 265. This document has also been updated and supersedes all closure plans for Phase IV ponds that FMC previously has provided to the Agency.

2.3 PROCESS AND UNIT DESCRIPTION

2.3.1 Waste Management

The FMC plant produced elemental phosphorus, which has generated two RCRA-regulated wastes that are managed in surface impoundments – phossy water and precipitator slurry. Only the phossy water waste stream was sent to the Phase IV ponds.

Elemental phosphorus oxidizes upon contact with air. In order to prevent oxidation, the elemental phosphorus produced at the plant was stored under water. The resulting stream was known as phossy water, which is any water that has come into contact with elemental phosphorus. Other sources of phossy water included water used for condensing gaseous phosphorus, purging pump packings, and handling or storing wastes. Phossy water contains elemental phosphorus as well as suspended and dissolved solids. Phossy water generated in the furnace building has occasionally tested as a RCRA toxicity characteristic hazardous waste, specifically for cadmium (EPA Hazardous Waste Code D006 per 40 C.F.R. §261.24). Blowdown from the Anderson scrubber at the Phos Dock also occasionally exceeded the toxicity characteristic for cadmium.

Prior to August 31, 1993, most of the phossy water streams, including the hazardous phossy water from the furnace building and the Phos Dock, were routed to the Phase IV pond system. Also in the past, some drummed phosphorus wastes were deposited in Pond 13S. As of August 31, 1993, the Phase IV ponds ceased receiving wastes that FMC analyses had determined to be hazardous. The furnace building phossy water was rerouted to Pond 16S (WMU #10). In 1991, FMC improved the Phos Dock scrubber performance, and the scrubber blowdown has not exhibited the characteristic for cadmium since that time. The Phase IV ponds received the following waste streams: Phos Dock North Solids Tank discharge, Phos Dock North East Sump discharge, industrial wastewater, and decant water from Pond 16S.

Phossy water routed to the Phase IV ponds was clarified in the ponds and recycled back to the plant for reuse. The four ponds were operated in series, so that water passed through at least two ponds in succession. The phossy water passed through the ponds and suspended solids were dropped out by gravity separation, with final clarification occurring in Pond 14S. To maintain treatment capacity in the ponds, FMC periodically dredged Ponds 11S, 12S and 13S to remove accumulated pond solids. The dredged solids were placed in one of FMC's hazardous waste surface impoundments, Pond 15S (WMU #3), until that unit ceased operations in 1993. Subsequently, the solids were placed in Pond 16S (WMU #10). Pond 14S functioned as a surge pond for the clarified, recyclable water. Pond 14S contained a little over 1 foot of accumulated solids, and was not dredged.

2.3.2 Unit Description

The Phase IV ponds are single-lined with 30-mil polyvinyl chloride (PVC). They are positioned adjacent to each other, and have the following approximate surface areas and capacities:

Pond	Area (acres)	Pond Capacity (acre-feet)	Bottom of Pond Elevation (feet)	Top of Pond Liner Elevation (feet)
11S	2.0	19	4451.5	4468.0
12S	2.1	22	4451.3	4467.8
13S	2.0	20	4451.1	4467.6
14S	2.8	33	4450.4	4466.9

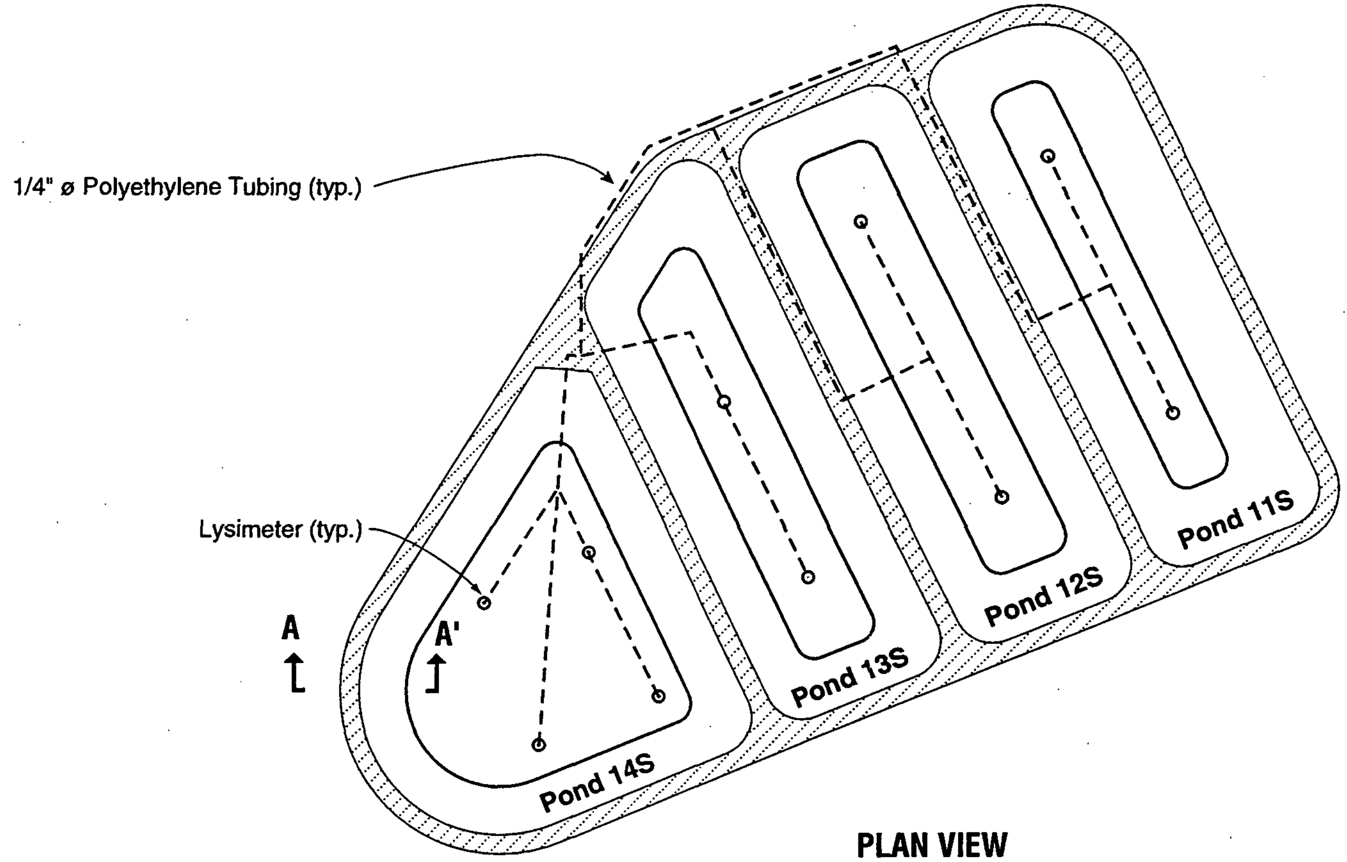
Native soil in the area of the unit is light brown, medium-density silt, with a trace of fine sand and clay. The embankments of each pond were built from the native soil and compacted to a minimum of 95 percent of modified proctor maximum density (AASHTO T-180). Optimum moisture content was found to be 12 percent, with a maximum density of 113.4 pounds per cubic foot.

The greatest height of the embankments relative to the surrounding terrain occurs at the southwest corner of Pond 14S, where the embankment is about 4 feet higher than the existing ground outside the pond. The embankments have a 3:1 slope on the inside.

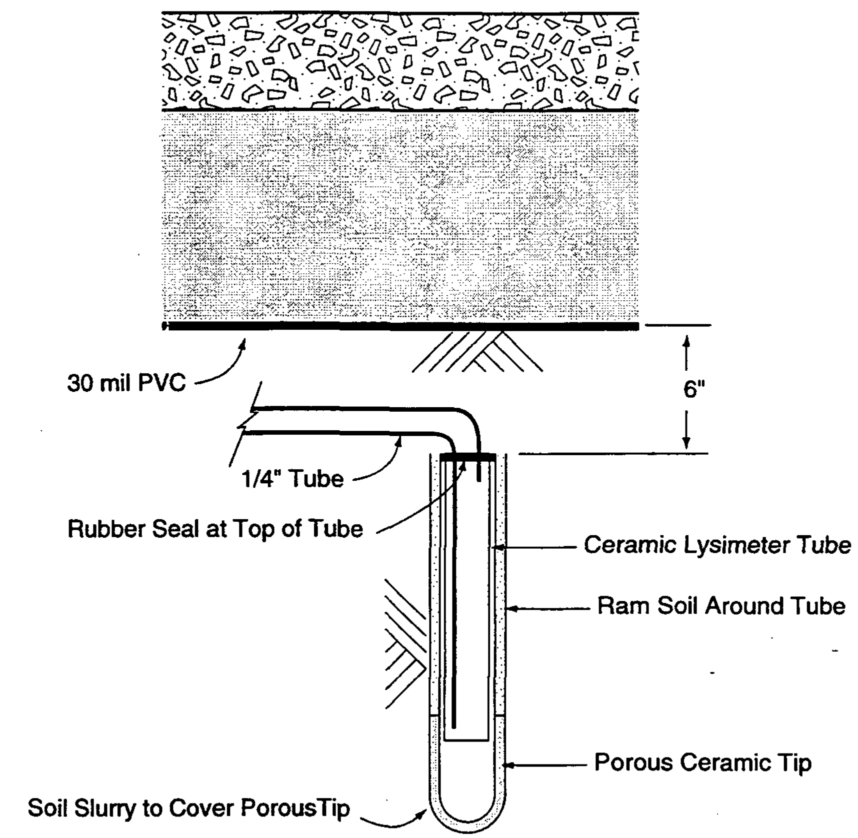
A cross section of the Phase IV ponds is illustrated in Figure 2-3. The subgrade below the bottom of each pond is native silty soil with the top one foot compacted to 90 percent maximum density. The subgrade was lined with a 30-mil flexible PVC liner. This liner conforms to the subgrade and provides a seal across the entire pond bottom surface.

To protect the PVC liner, a 1-foot-thick layer of native silty soil, free of rock and debris, was placed on top of the liner and compacted to 90 percent maximum density. Above this, a 6-inch-thick layer of crushed slag was placed to further protect the liner system and to provide a level bottom surface for excavation equipment in the future.

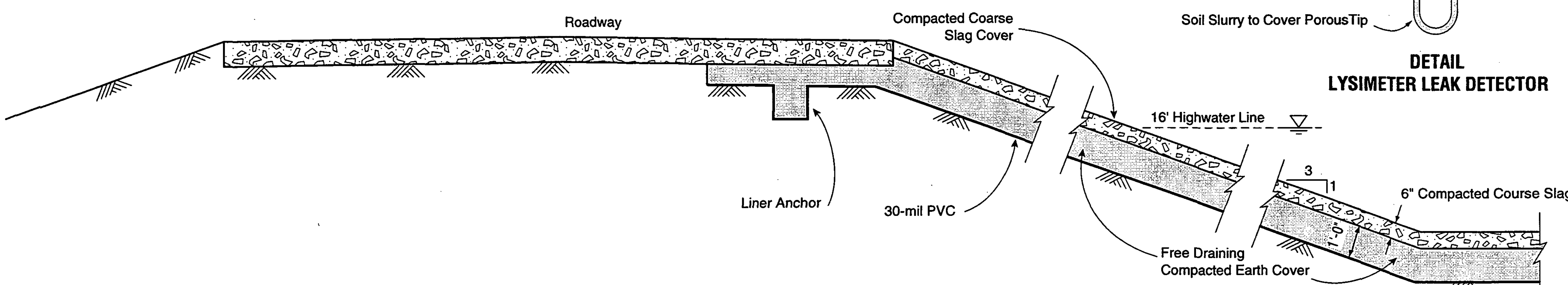
The embankment subgrade of each pond was constructed of native silty soils compacted to 95 percent maximum density. The PVC liner used on the bottom of each pond was extended up the embankment and anchored in a continuous 1-foot-deep square trench at the top of the embankment. A 1-foot-thick compacted silty soil layer was also placed above the liner to the top of the embankment, and overlain by a 6- to 9-inch thick layer of compacted coarse slag.



PLAN VIEW



DETAIL
LYSIMETER LEAK DETECTOR



SECTION A-A'

Source: FMC Drawing Nos.
38729, revision 8,
38730, revision 1,
38731, revision D.

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BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Phase IV Ponds **Original Construction**		
Job Number	Drawing No.	Rev.
24230	Figure 2-3	1

The Phase IV ponds were originally installed with a leak detection system consisting of lysimeters. However, the leak detection system is no longer functional.

2.3.3 Current Status

The Phase IV ponds have not received wastes that FMC testing had determined to be hazardous since August 30, 1993 and stopped receiving wastes in November 1998. FMC dredged the solids from Ponds 11S, 12S and 13S to the extent practicable and placed them into Pond 15S (WMU #3) prior to September 1, 1993, and in Pond 16S (WMU #10) thereafter. Pond 14S has not contained significant amounts of pond solids requiring dredging. Dredging operations were carefully controlled to avoid impairing the integrity of the liner. The pond solids were removed until the protective slag base, which covers the liner, was approached.

The unit contained phossy wastewater and pond solids accumulated since the 1993 dredging operations. FMC will close the unit with wastes in-place. Existing pond solids in the unit will therefore not be removed from the unit. Pond solids were dredged out of Pond 11S into Pond 13S in early 1999 prior to construction activities to reduce the likelihood of releases during closure activities. The initial fill and temporary cap construction activities were completed on October 24, 1999. Interim dewatering and settlement monitoring are currently being performed. Closure activities are being conducted in accordance with the requirements of 40 C.F.R. §265.228(a)(2) for closure-in-place.

2.4 CLOSURE PLAN ORGANIZATION

This plan contains the following information:

- Section 3 discusses the regional and site characteristics, and the maximum waste inventory for the Phase IV ponds.
- Section 4 describes the groundwater monitoring program.
- Section 5 contains a description of the groundwater quality assessment.
- Section 6 presents a summary of the closure activities, the rationale for these activities, and the closure schedule.
- Section 7 discusses the requirements and parameters considered for the proposed RCRA cap.

- Section 8 describes details on closure procedures, including site preparation, backfilling, equipment decontamination, monitoring activities, and cap installation.
- Section 9 provides the closure certification that will be submitted to EPA upon completion of closure.
- Section 10 discusses the post-closure care activities that will be conducted subsequent to closure completion.
- Section 11 presents the cost estimates for closure and post-closure care for the unit.
- Section 12 contains financial assurance documentation for the estimated closure/post-closure costs.
- Section 13 contains a list of referenced documents used in the preparation of this closure plan.
- Section 14 contains an indexed completion checklist for closure plan sections with regulatory requirements.

This closure plan also includes a number of appendices. Appendices A and B contain specific monitoring well geologic logs and completion diagrams, respectively. Appendix C provides the RCRA/CERCLA Memorandum of Understanding for the FMC Pocatello Plant, dated April 19, 1991, and an EPA memorandum entitled "Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities," from Steven Herman and Elliott Laws, (Assistant Administrators, OECA and OSWER, respectively), dated September 24, 1996. Appendix D contains correspondence between FMC and EPA regarding reductions to analytical parameters for FMC's RCRA groundwater monitoring program. Appendix E contains the Field Sampling Plan for Equipment Decontamination Confirmation during closure activities, and Appendix F provides groundwater chemistry statistics for the unit. Appendix G contains the Health and Safety Plan that will be followed during closure of the Phase IV ponds, while Appendix H presents the results of HELP modeling performed for the proposed and RCRA guidance caps. The technical specifications, instrument data sheets, and drawings for the proposed final cover, as well as the Construction Quality Assurance Plan, are included in Appendix I. Appendix J (not used) has been replaced by Calc. 24230-027-4 "Settlement Evaluation Final Cap" which is contained in Appendix M. Appendix K presents the results of geotechnical investigations conducted in 1993 on wastes from the Pond 8E and Phase IV ponds. Appendix L contains the laboratory results for geotechnical analyses performed on Pond 8E and Phase IV ponds samples in 1994. Appendix M contains geotechnical and stormwater drainage calculations for the proposed final cover for the Phase IV ponds. Appendix N contains vendor information and test data on the compatibility of the proposed cover liner material with the waste in the unit.

Site Characteristics

3.1 GENERAL

The FMC plant is located at the base of the northern slope of the Bannock Range, where it merges with the Snake River Plain. The plant is approximately 1 mile west of the Portneuf River, and 4 miles southeast of the American Falls Reservoir, which is on the Snake River (Figure 2-1). The general site area is situated on the southern margin of the Eastern Michaud Flats at the base of the northernmost mountain of the Bannock Range. The Michaud Flats are part of the extensive Snake River Plain.

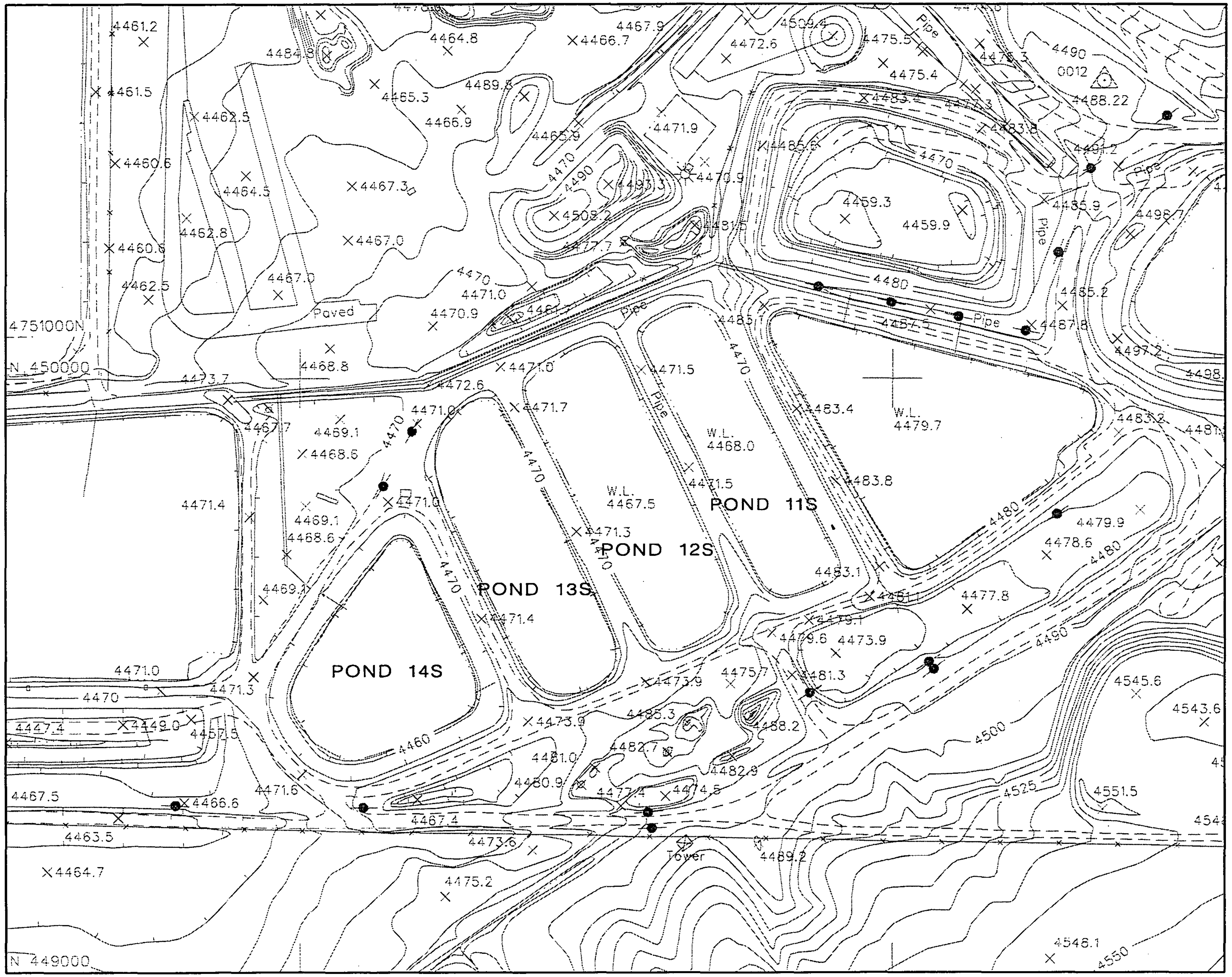
The Portneuf River, a major tributary of the Snake River drainage system, is the only perennial stream near the FMC facility. The river flows to the northwest through Pocatello and discharges into the American Falls Reservoir. The FMC facility is not subject to flooding by 100-year peak floods by either river. A detailed description of the 100-year flood plain within the region of interest is presented in Section B.3.2 (Volume 1) of the RCRA Part B Permit Application. (FMC 1997b, revised 1998).

The surface elevation within the FMC property ranges from approximately 4,440 feet above mean sea level (MSL) at the northern boundary of the facility to about 5,200 feet in the south (Figure 2-1). Within the operational areas of the FMC plant, the ground elevation ranges from approximately 4,450 to 4,500 feet above MSL. A site topographic map for the Phase IV ponds vicinity is presented in Figure 3-1.

A discussion of regional and site characteristics including climate, surface conditions, subsurface conditions, groundwater, and hydrogeology is presented in the *RCRA Interim Status Groundwater Monitoring Assessment* (FMC 1993), and in the *Remedial Investigation Report for the Eastern Michaud Flats Site* (Bechtel 1996b). These publications were submitted to EPA on August 24, 1993, and August 23, 1996, respectively.

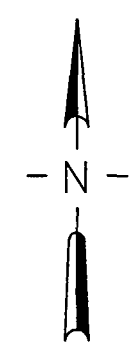
3.2 CLOSURE SITE AREA

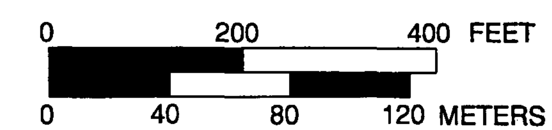
The Phase IV ponds waste management unit (WMU #8) is located in the southwestern part of the FMC plant facilities (Figure 2-2). FMC will close the Phase IV ponds with wastes in place.



Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.

Date of Photography: June 1992





BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC IDAHO, LLC
POCATELLO, IDAHO

Phase IV Ponds - Site Topography

Job Number	Drawing No.	Rev.
24230	FIGURE 3-1	1

SFOSB092\BS EMF DRAW\ROOT\FMC-RCRA\ BE IV\CLO\ p4etopo.dgn
04/29/02dc(REF. FMC-RCRA\TNERAY\ ph4topo.dgn)

The proposed limits of the final cap (LFC) are indicated by the cap area on Drawings 270-C-213 and 270-C-217 (Appendix I). For the purposes of this closure plan, the boundaries of the waste management unit (WMU #8) are considered to be the same as the LFC, and the LFC defines the "closure area".

The closure area was determined on the basis of the operation and management of the pond. Wastes were discharged into the Phase IV Ponds via a permanent piping system. The closure area encompasses all four ponds (11S, 12S, 13S, and 14S), the ponds contents, interior dikes, and the entire top of the perimeter dikes around all four ponds.

The Phase IV Ponds were constructed over a previously used unlined precipitator slurry surface impoundment known as Pond 3E. The wastes from this former pond were dried and excavated down to native soils prior to construction of the Phase IV Ponds. There have been no instances of overtopping the dikes at the Phase IV Ponds. Therefore, the closure area (and coinciding LFC) for the Phase IV Ponds is appropriate because it consists of the area where the Phase IV Ponds waste management activities took place. Hydrogeologic information is outlined in detail in the *RCRA Interim Status Groundwater Monitoring Assessment* (FMC 1993). Groundwater at the facility is monitored by upgradient and downgradient wells, as discussed in Sections 4 and 5 of this closure plan.

3.3 MAXIMUM WASTE INVENTORY

The Phase IV ponds were constructed with a design capacity of 94 acre-feet. Per an FMC survey, the amount of waste present in the ponds when waste receipt ceased was 43.3 acre feet or approximately 70,000 cubic yards. The amount of waste present in each pond was as follows:

Pond 11S	19.0 acre-feet
Pond 12S	19.0 acre-feet
Pond 13S	3.8 acre-feet
Pond 14S	1.5 acre-feet

When the Phase IV ponds stopped receiving waste Pond 11S was full to capacity. An additional 3 acre-feet of waste was received by the remaining ponds prior to initiating closure activities. Thus, the maximum waste inventory for purposes of this Phase IV Ponds Closure Plan is 46.3 acre-feet.

Groundwater Monitoring

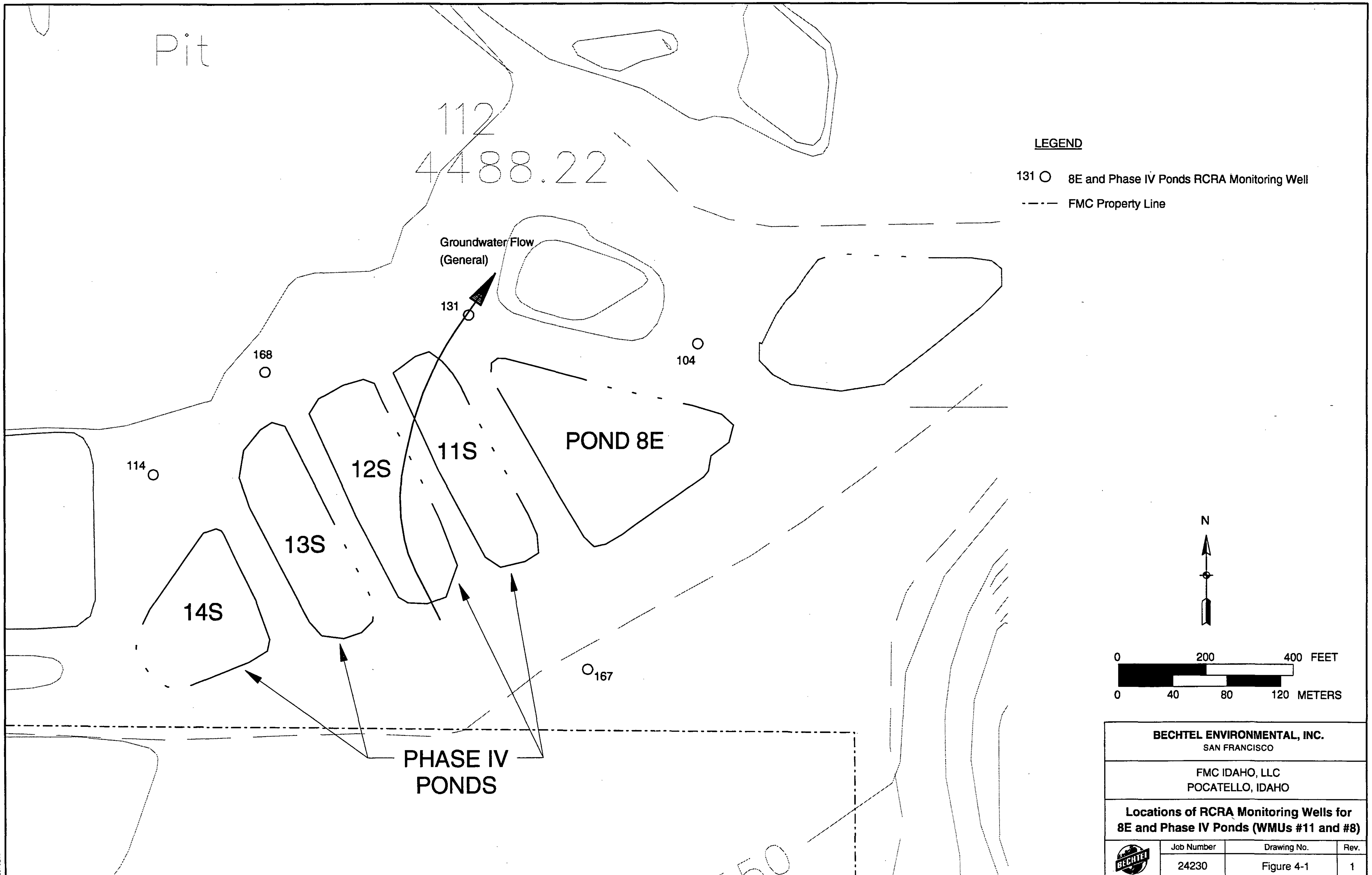
This section presents a description of the current Phase IV ponds groundwater monitoring program which will be continued during the closure and post-closure periods. The objective of the monitoring program is to identify whether increases in hazardous constituent concentrations attributable to the Phase IV ponds occur downgradient of the closed unit. Section 4.1 describes the proposed monitoring well network, and Section 4.2 presents the monitoring frequency and summarizes the monitoring procedures.

4.1 MONITORING WELL NETWORK

The current RCRA groundwater monitoring well network for the Phase IV ponds consists of one upgradient well (Well 167) and four downgradient wells (Wells 104, 114, 131, and 168). It should be noted that due to the proximity of the Phase IV ponds to Pond 8E (WMU #11) (Figure 4-1), these wells also serve as the RCRA groundwater monitoring network for Pond 8E per 40 C.F.R. §265.91(b).

Wells 104, 114, and 131 were installed in September 1990. An additional four wells (Wells 116, 130, 137, and 132) also functioned as part of the RCRA groundwater monitoring system for Pond 8E and the Phase IV ponds until September 1995, when Wells 167 and 168 were installed as replacement wells. Specifically, upgradient Well 167 replaced Wells 116, 130, and 137, and the downgradient Well 168 replaced Well 132.

The locations of the current Phase IV ponds RCRA groundwater monitoring wells are shown on Figure 4-1. Upgradient Well 167 is located southeast of the Phase IV ponds, and its casing is 139.0 feet deep. Downgradient Well 104 is 109.0 feet deep and located to the far northeast of the Phase IV ponds, while Well 131 is a 165.6-foot-deep well located to the north of Pond 11S, one of the Phase IV ponds. Downgradient Wells 168 and 114 are located along the northwest and west perimeters of the unit, respectively, with Well 168 being 93.0 feet deep, and Well 114, 129.0 feet deep. A summary of the monitoring well screened intervals is provided in Table 4-1. The drilling logs and well completion diagrams of wells in the monitoring network, as well as those used to develop the description of site hydrogeology presented in Section 5, are provided in Appendices A and B.



Pit
112
4488.22
Groundwater Flow
(General)
131
168
104
114
167
POND 8E
11S
12S
13S
14S
PHASE IV
PONDS
LEGEND
131 ○ 8E and Phase IV Ponds RCRA Monitoring Well
FMC Property Line
N
0 200 400 FEET
0 40 80 120 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC IDAHO, LLC
POCATELLO, IDAHO
Locations of RCRA Monitoring Wells for
8E and Phase IV Ponds (WMUs #11 and #8)
Job Number
24230
Drawing No.
Figure 4-1
Rev.
1

TABLE 4-1
MONITORING WELL CONSTRUCTION SUMMARY

Well No.	Well Casing Depth (feet bgs)	Well Diameter (inches)	Slot Size (inches)	Screen Interval (feet msl)
167	139.0	4	0.02	4373.6 - 4353.6
104	109.0	4	0.02	4388.1 – 4378.1
114	129.0	4	0.02	4351.9 - 4342.4
131	165.6	4	0.02	4330.6 - 4320.6
168	93.0	4	0.02	4396.1 - 4381.1

Notes: All well casings and screens are Schedule 40 PVC material, except Well 131 which is Schedule 80 PVC. Screens are machine cut (manufactured).
bgs = below ground surface

4.2 MONITORING FREQUENCY, PROCEDURES, AND STATISTICAL ANALYSIS

Chemical analytical data and groundwater level measurements have been collected on a quarterly basis since RCRA groundwater monitoring for the unit was initiated in September 1990. Since 1992, additional monitoring wells were installed as part of the CERCLA RI/FS effort. Monitoring at the CERCLA wells was conducted on a quarterly basis from April 1992 through December 1994, and has been conducted semi-annually thereafter. The results are submitted to EPA Region 10 for review in accordance with the EPA RCRA/CERCLA Memorandum of Understanding (included in Appendix C in this plan), and in the *RCRA Interim Status Groundwater Monitoring Assessment* reports submitted annually (FMC 1993; FMC 1994; FMC 1995; FMC 1996a; FMC 1997a; FMC 1998b; FMC 1999b; FMC 2000; and Astaris 2001a). The annual reports specifically address FMC's RCRA surface impoundments, including the Phase IV ponds.

The *RCRA Interim Status 2000 Groundwater Monitoring Assessment* (Astaris 2001a) included statistical analyses for three indicator parameters: arsenic, fluoride, and selenium. Time-series plots of these parameters were created wherein mean values for the reporting year were compared to those of previous years. Where the current values were higher for any indicator, a Mann-Whitney non-parametric test was conducted to assess the significance of the increase. In addition, qualitative evaluations were performed for the other indicator parameters reported, including potassium, which has been shown to be a very good indicator parameter for recent releases. Both statistical and qualitative methods conclude that the Phase IV ponds have not released constituents to groundwater (Astaris 2001a).

During the initial phases of the closure period, FMC proposes to continue quarterly groundwater monitoring and analyses at the Phase IV ponds, consistent with the RCRA alternate monitoring program (per 40 C.F.R. §§265.93(d) and (e)) being implemented at FMC's other WMUs, as outlined in the June 1995 correspondence between EPA and FMC (Appendix C) and the *RCRA Interim Status Groundwater Monitoring Plan* (FMC 1999b). Consistent with the June 1995 correspondence between EPA and FMC (Appendix D), groundwater samples collected from the unit's monitoring wells will be analyzed for the following analytical and physical parameters:

- arsenic
- cadmium
- chloride
- fluoride
- nitrate
- potassium
- selenium
- orthophosphate
- ammonia
- sulfate
- specific conductance
- turbidity
- pH
- temperature

These samples will be collected in accordance with the procedures described in the Sampling and Analysis Plan (Attachments 10-1 [QAPjP] and 10-2a [FSP] in Section 10). The groundwater surface elevation will be determined each time the groundwater is sampled. Groundwater monitoring data will be maintained by FMC, and the results of the groundwater quality assessments will be submitted annually to EPA. Groundwater quality data will be evaluated quarterly and statistically analyzed annually. The statistical analyses used by FMC are described in the *RCRA Interim Status Groundwater Monitoring Plan* (FMC 1999b).

5 Groundwater Assessment

Groundwater Assessment

This section presents a description of groundwater conditions at the Phase IV ponds (WMU #8). Section 5.1 describes the site hydrogeology and Section 5.2 summarizes the groundwater chemistry.

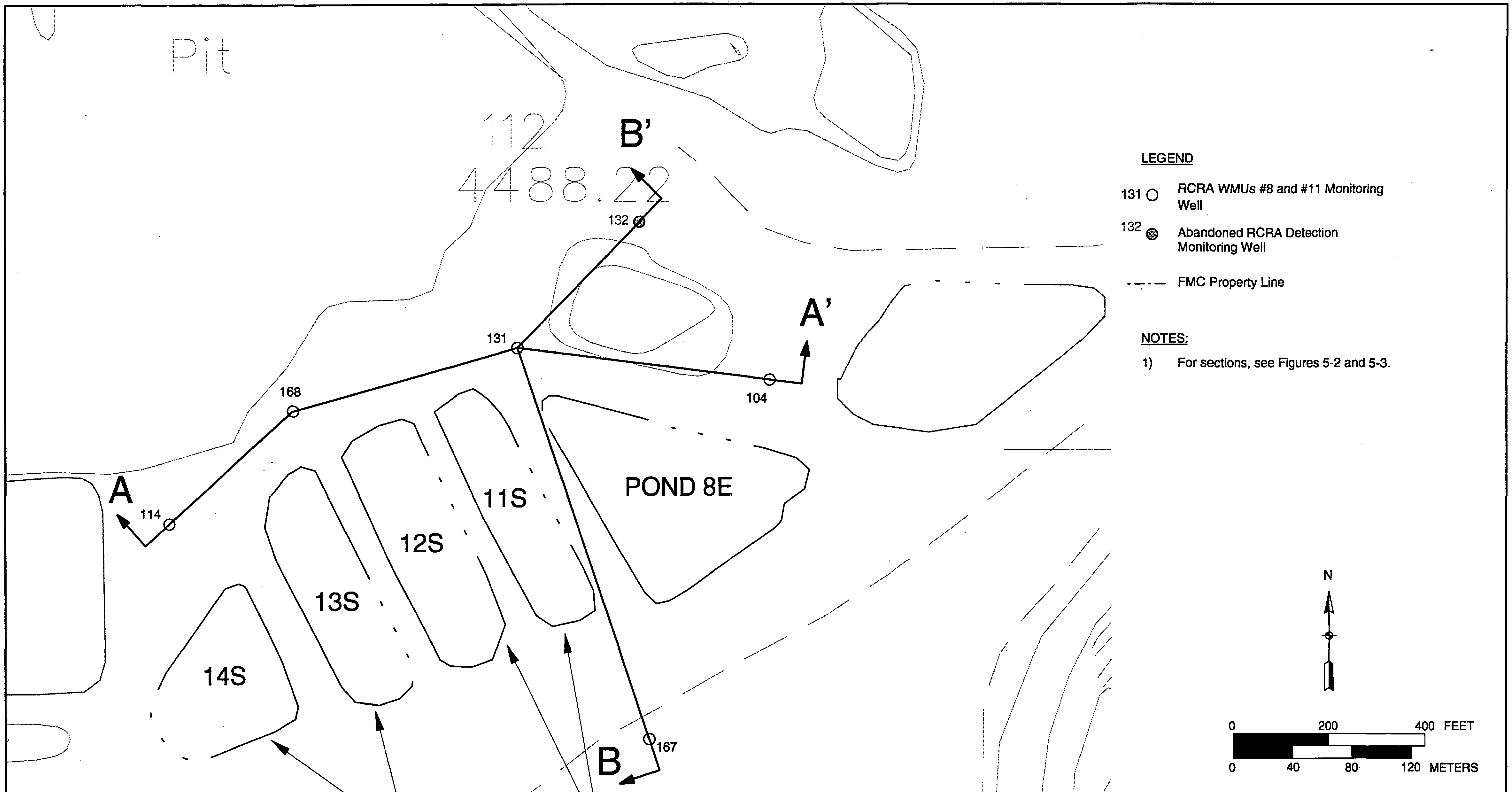
5.1 HYDROGEOLOGY

This description of the hydrogeology of the Phase IV ponds area is based on geologic logs and well completion diagrams (Wells 104, 114, 131, 132, 167, and 168) which are provided in Appendices A and B, respectively. Also used to develop this description were hydrogeologic and geochemical information in the *Remedial Investigation Report for the Eastern Michaud Flats Site* (Bechtel 1996b), and the groundwater chemistry information in the *RCRA Interim Status 2000 Groundwater Monitoring Assessment* (Astaris 2001a).

The hydrogeology in the Phase IV ponds area is transitional between that of the Bannock Range and that of the Michaud Flats. In the Bannock Range, groundwater flows through low permeability, undifferentiated, and apparently discontinuous sedimentary and volcanic rock units under steep gradients. In the Michaud Flats, groundwater flows through relatively continuous, high conductivity basalt and gravel aquifers under flatter gradients. The transitional zone is characterized by small, heterogeneous coalescing alluvial fans where groundwater flow occurs predominantly within localized sand and gravel lenses.

The hydrogeology in the Phase IV ponds area is illustrated on cross sections A-A' and B-B' (Figures 5-1 to 5-3). The upper geologic unit beneath Phase IV ponds is an approximately 85-foot-thick, unsaturated silt containing several silty gravel layers. These gravel layers occur at depths of 15 and 40 feet, are approximately 10 to 20 feet thick, and consist of quartzitic, volcanic, and minor calcareous clasts. These layers appear continuous beneath the unit, thicken to the northeast, and represent the edge of an alluvial fan deposit.

Groundwater is first encountered in a silt aquitard which is underlain by a 10- to 40-foot-thick layer of gravel of metamorphic and volcanic lithology. The gravel is the uppermost aquifer beneath the Phase IV ponds. This gravel is discontinuous through the Phase IV ponds area, and becomes thicker to the north. The gravel is underlain, in places, by a saturated clay layer, which ranges from approximately 10 to 45 feet thick. Due to the geologic setting of Phase IV ponds, the uppermost aquifer is more of a discontinuous series of gravels that are likely to be hydraulically interconnected. In some areas, the uppermost aquifer may be a silty sand or sandy silt (Well 167) due to lateral facies changes. In other areas, the uppermost aquifer is a permeable gravel (Well 132). Well 168 was installed in a sandy silt, which may actually be the aquitard in this area.



BECHTEL ENVIRONMENTAL, INC.
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POCATELLO, IDAHO

Locations of Hydrogeologic Sections 8E and Phase IV Ponds (WMUs #11 and #8)

Job Number	Drawing No.	Rev.
24230	Figure 5-1	1

SFOSB092\BS EMF DRAW\ROOT\FMCA-RCRA\ 8E IVCLO\P4xsec.dgn
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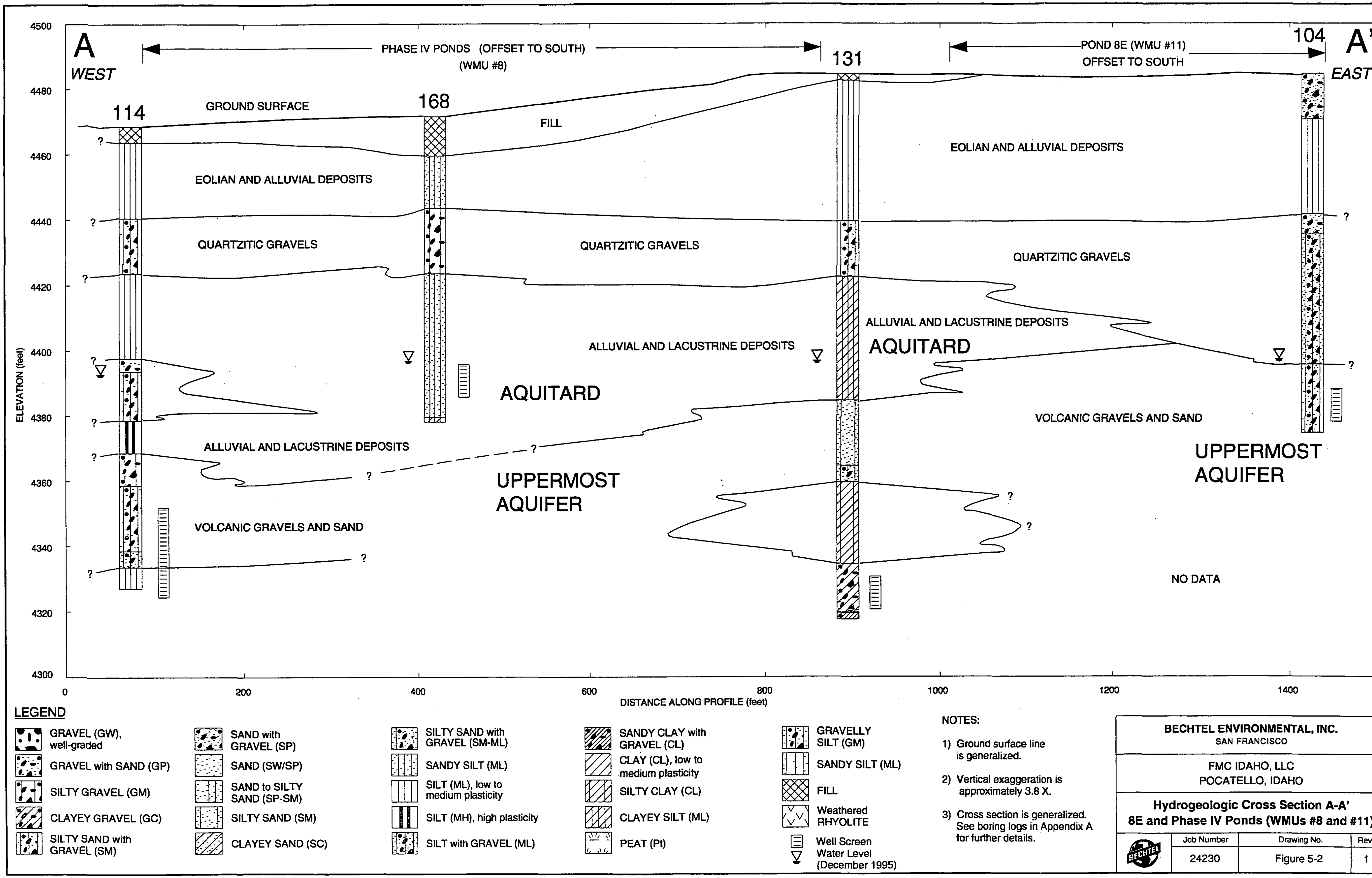
A
WEST
A'
EAST
PHASE IV PONDS (OFFSET TO SOUTH)
(WMU #8)
POND 8E (WMU #11)
OFFSET TO SOUTH
114
168
131
104
GROUND SURFACE
FILL
EOLIAN AND ALLUVIAL DEPOSITS
QUARTZITIC GRAVELS
ALLUVIAL AND LACUSTRINE DEPOSITS
AQUITARD
UPPERMOST
AQUIFER
VOLCANIC GRAVELS AND SAND
NO DATA
ELEVATION (feet)
4500
4480
4460
4440
4420
4400
4380
4360
4340
4320
4300
0
200
400
600
800
1000
1200
1400
DISTANCE ALONG PROFILE (feet)
LEGEND
GRAVEL (GW), well-graded
GRAVEL with SAND (GP)
SILTY GRAVEL (GM)
CLAYEY GRAVEL (GC)
SILTY SAND with GRAVEL (SM)
SAND with GRAVEL (SP)
SAND (SW/SP)
SAND to SILTY SAND (SP-SM)
SILTY SAND (SM)
CLAYEY SAND (SC)
SILTY SAND with GRAVEL (SM-ML)
SANDY SILT (ML)
SILT (ML), low to medium plasticity
SILT (MH), high plasticity
SILT with GRAVEL (ML)
SANDY CLAY with GRAVEL (CL)
CLAY (CL), low to medium plasticity
SILTY CLAY (CL)
CLAYEY SILT (ML)
PEAT (Pt)
GRAVELLY SILT (GM)
SANDY SILT (ML)
FILL
Weathered RHYOLITE
Well Screen
Water Level (December 1995)
NOTES:
1) Ground surface line is generalized.
2) Vertical exaggeration is approximately 3.8 X.
3) Cross section is generalized. See boring logs in Appendix A for further details.
BECHTEL ENVIRONMENTAL, INC.
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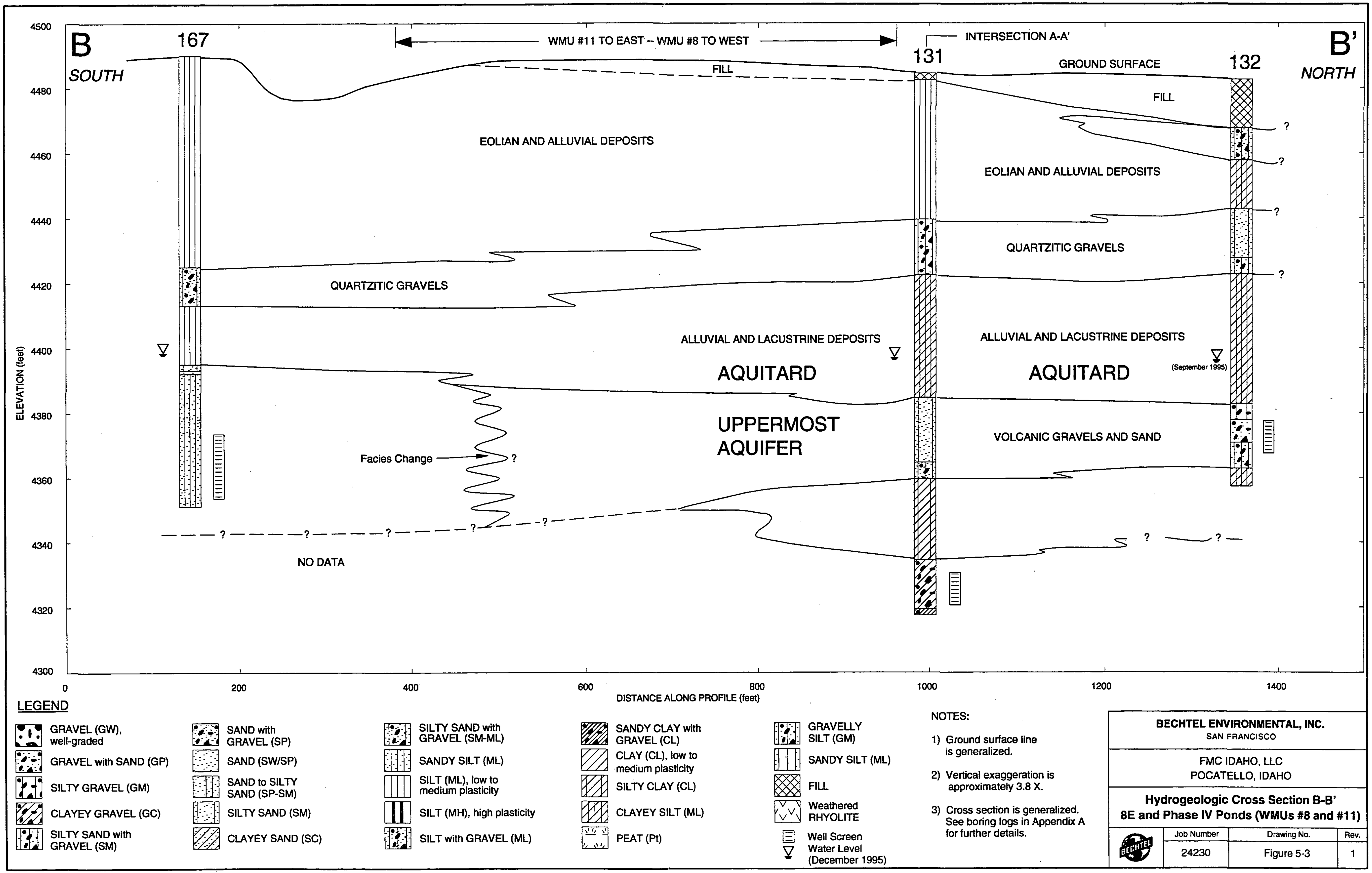
POCATELLO, IDAHO
Hydrogeologic Cross Section A-A'
8E and Phase IV Ponds (WMUs #8 and #11)
BECHTEL
Job Number
24230
Drawing No.
Figure 5-2
Rev.
1


B
SOUTH
B'
NORTH
167
131
132
WMU #11 TO EAST – WMU #8 TO WEST
INTERSECTION A-A'
GROUND SURFACE
FILL
EOLIAN AND ALLUVIAL DEPOSITS
QUARTZITIC GRAVELS
ALLUVIAL AND LACUSTRINE DEPOSITS
AQUITARD
UPPERMOST AQUIFER
VOLCANIC GRAVELS AND SAND
Facies Change
NO DATA
(September 1995)
ELEVATION (feet)
DISTANCE ALONG PROFILE (feet)
4500
4480
4460
4440
4420
4400
4380
4360
4340
4320
4300
0
200
400
600
800
1000
1200
1400
LEGEND
GRAVEL (GW), well-graded
GRAVEL with SAND (GP)
SILTY GRAVEL (GM)
CLAYEY GRAVEL (GC)
SILTY SAND with GRAVEL (SM)
SAND with GRAVEL (SP)
SAND (SW/SP)
SAND to SILTY SAND (SP-SM)
SILTY SAND (SM)
CLAYEY SAND (SC)
SILTY SAND with GRAVEL (SM-ML)
SANDY SILT (ML)
SILT (ML), low to medium plasticity
SILT (MH), high plasticity
SILT with GRAVEL (ML)
SANDY CLAY with GRAVEL (CL)
CLAY (CL), low to medium plasticity
SILTY CLAY (CL)
CLAYEY SILT (ML)
PEAT (Pt)
GRAVELLY SILT (GM)
SANDY SILT (ML)
FILL
Weathered RHYOLITE
Well Screen
Water Level (December 1995)
NOTES:
1) Ground surface line is generalized.
2) Vertical exaggeration is approximately 3.8 X.
3) Cross section is generalized. See boring logs in Appendix A for further details.
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC IDAHO, LLC
POCATELLO, IDAHO
Hydrogeologic Cross Section B-B'
8E and Phase IV Ponds (WMUs #8 and #11)
Job Number
24230
Drawing No.
Figure 5-3
Rev.
1

Groundwater is encountered at an approximate depth of 90 feet in the Phase IV ponds area, which corresponds to an elevation of 4,397 feet mean sea level. Seasonal fluctuations in water levels are on the order of 0.5 to 3 feet, with the higher elevations occurring during the winter months. The hydrographs for the Phase IV ponds monitoring wells for the period October 1990 through November 2000 are presented in Figure 5-5.

Groundwater flow in the shallow aquifer in the Phase IV ponds area is to the north, as shown in the contours of November 2000 (Figure 5-4). The horizontal hydraulic gradient ranged from approximately 0.0012 to 0.0021 as measured between upgradient Well 167 and downgradient Well 131 between December 1995 and November 2000. No significant seasonal or other temporal changes in this flow pattern are apparent.

Vertical potentiometric head differences measured in June 1994 are shown in Figure 5-6. During the period June 1992 to May 1998, vertical potentiometric head differences in shallow/deep well pair 103/104 generally indicated upward flow potential in this area, ranging from approximately 0.01 to 0.18 feet.

The results of slug tests conducted in Well 104 indicate the hydraulic conductivity of the shallow aquifer in the Phase IV ponds area is 126 feet/day (0.044 centimeters per second). This hydraulic conductivity may be used to estimate the average groundwater seepage velocity using the following equation:

$$V = Ki / n$$

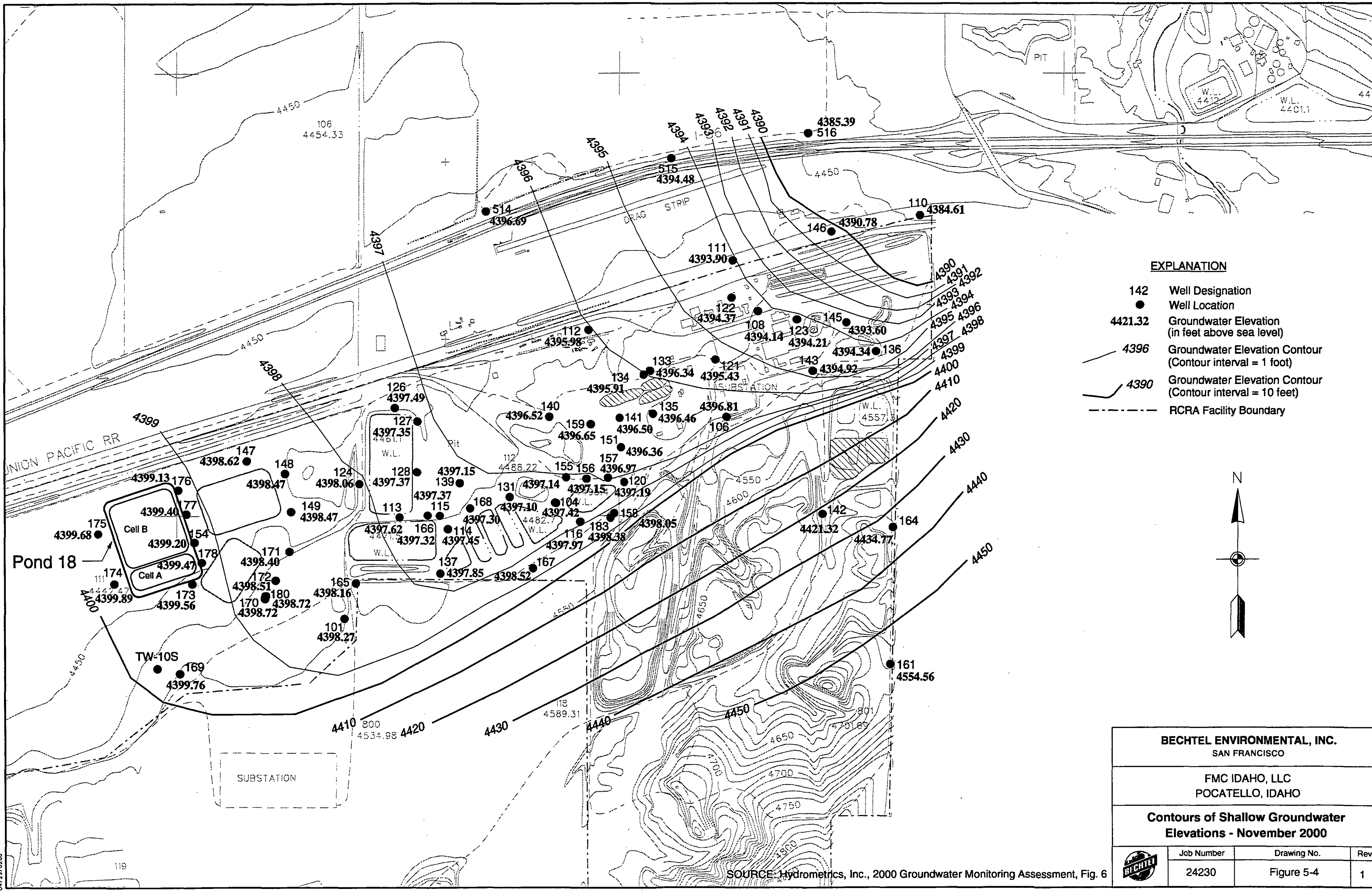
where:

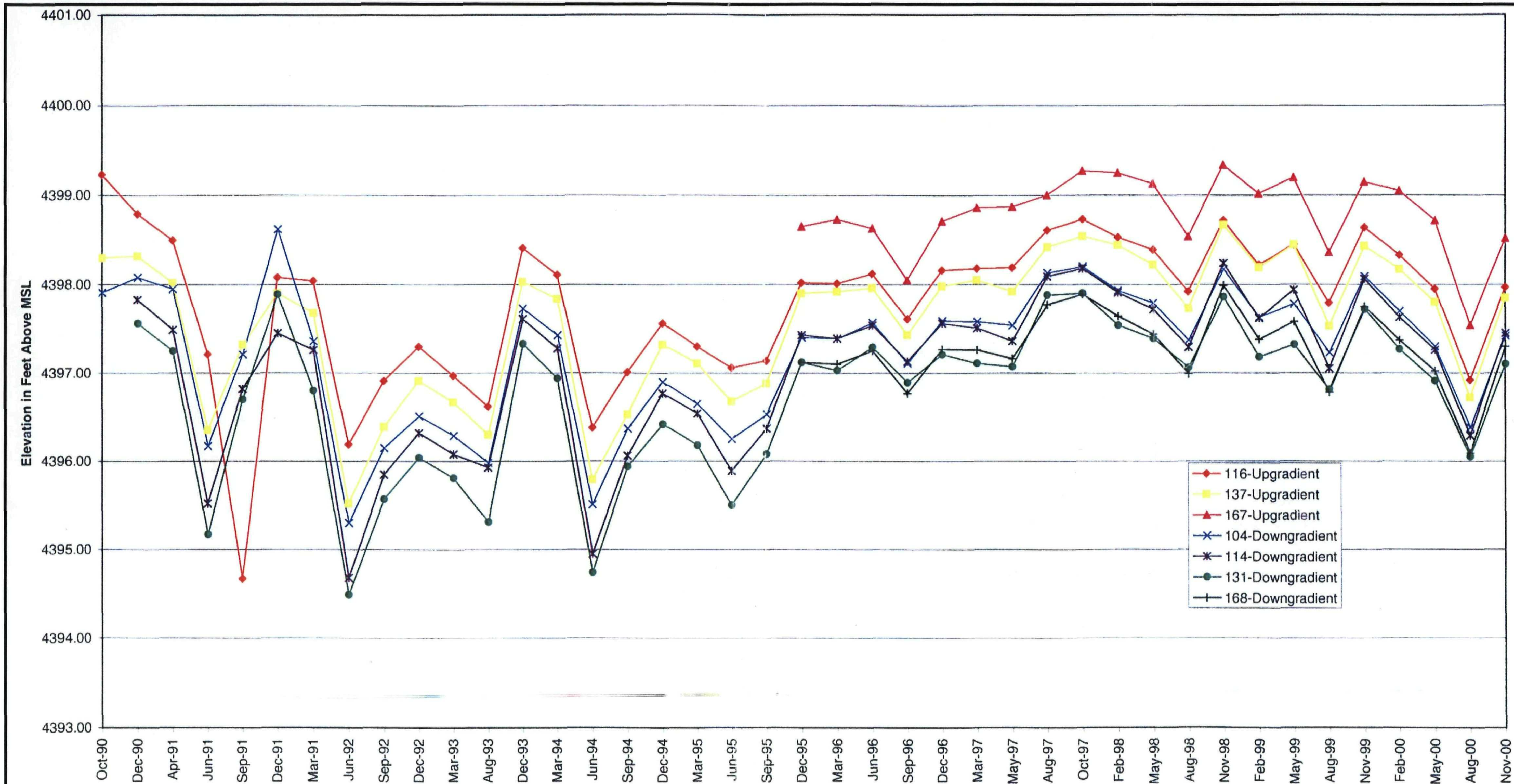
V = average groundwater seepage velocity in feet per day;

K = hydraulic conductivity in feet per day;

i = horizontal hydraulic gradient (dimensionless); and

n = effective aquifer porosity (dimensionless).


EXPLANATION
142 Well Designation
Well Location
4421.32 Groundwater Elevation (in feet above sea level)
4396 Groundwater Elevation Contour (Contour interval = 1 foot)
4390 Groundwater Elevation Contour (Contour interval = 10 feet)
RCRA Facility Boundary
N
UNION PACIFIC RR
DRAG STRIP
Pond 18
Cell B
Cell A
SUBSTATION
PIT
W.L.
TW-10S
SOURCE: Hydrometrics, Inc., 2000 Groundwater Monitoring Assessment, Fig. 6
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC IDAHO, LLC
POCATELLO, IDAHO
Contours of Shallow Groundwater Elevations - November 2000
Job Number
24230
Drawing No.
Figure 5-4
Rev.
1



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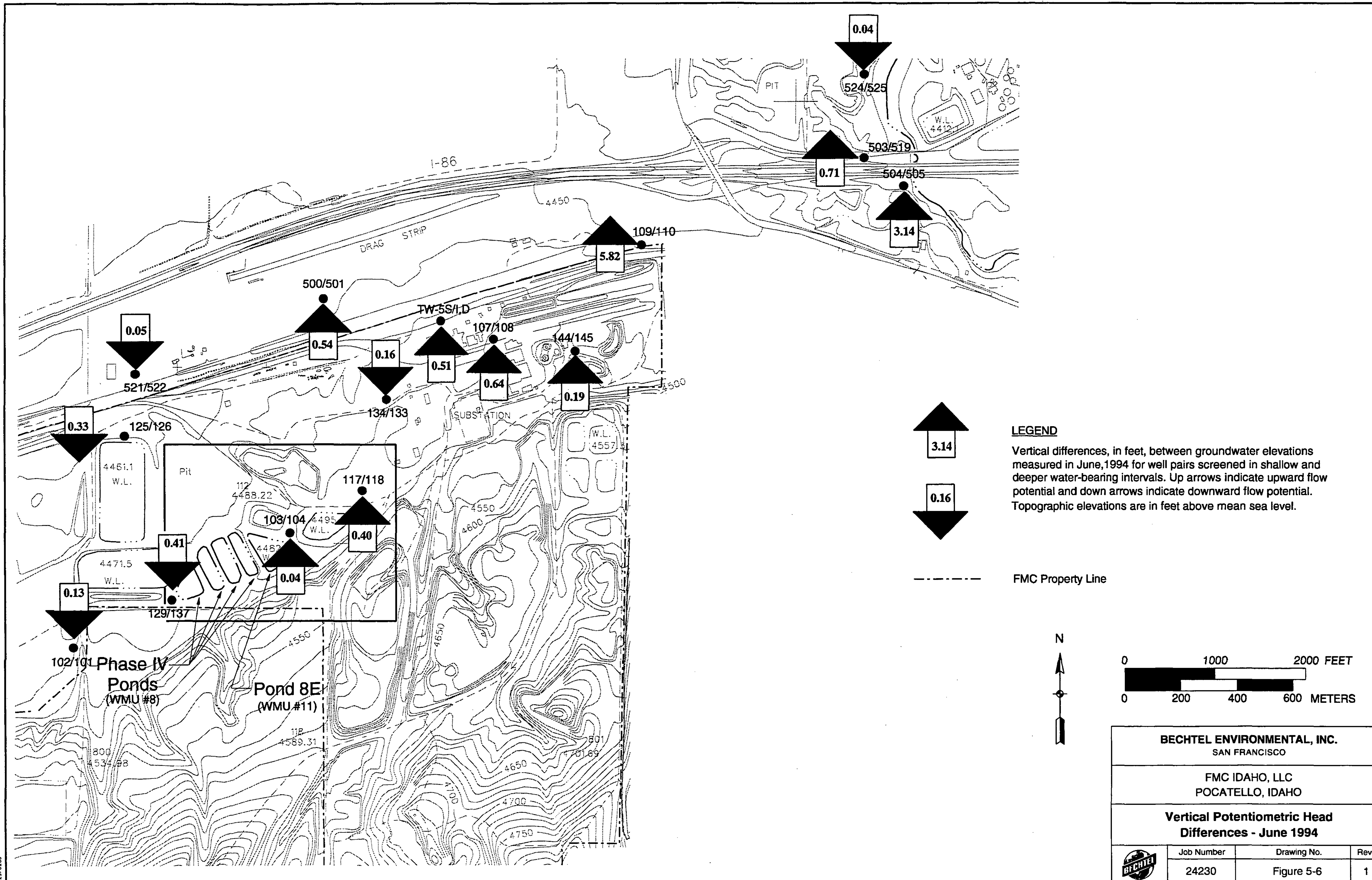
04/29/02da

SOURCE: Hydrometrics, Inc., 2000 Ground Water Monitoring Assessment, Figure 10

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Hydrographs for Monitoring Wells in the Vicinity of Phase IV and 8E Ponds (WMU #8 and WMU #11)		
Job Number	Drawing No.	Rev.
24230	Figure 5-5	1



I-86
DRAG STRIP
PIT
SUBSTATION
Pit
Phase IV Ponds
(WMU #8)
Pond 8E
(WMU #11)
524/525
0.04
503/519
0.71
504/505
3.14
109/110
5.82
500/501
0.54
TW-5S/I,D
0.51
107/108
0.64
144/145
0.19
0.16
134/133
0.05
521/522
0.33
125/126
117/118
0.40
103/104
0.04
0.41
129/137
0.13
102/101
LEGEND
Vertical differences, in feet, between groundwater elevations measured in June,1994 for well pairs screened in shallow and deeper water-bearing intervals. Up arrows indicate upward flow potential and down arrows indicate downward flow potential. Topographic elevations are in feet above mean sea level.
3.14
0.16
FMC Property Line
N
0 1000 2000 FEET
0 200 400 600 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC IDAHO, LLC
POCATELLO, IDAHO
Vertical Potentiometric Head Differences - June 1994
Job Number 24230
Drawing No. Figure 5-6
Rev. 1

The effective porosity of the upper aquifer was estimated at 20 percent and the value used for the hydraulic gradient was 0.0016, which is the average for the period December 1995 through November 2000. Using these values in the above equation yields an estimated seepage velocity of 1.10 feet per day.

The aquifer cross-sectional area was estimated to have a width of 600 feet and a thickness of 20 feet. The groundwater flux beneath the pond was estimated to be 18,000 gallons per day (2,400 cubic feet per day), using the following equation:

$$Q = KiA$$

where:

Q = groundwater flux in cubic feet per day;

K = hydraulic conductivity in feet per day;

i = horizontal hydraulic gradient (dimensionless); and

A = cross-sectional area in square feet of aquifer beneath the Phase IV ponds, perpendicular to flow direction.

5.2 GROUNDWATER CHEMISTRY

The groundwater chemistry information for wells in the Phase IV ponds monitoring network is summarized in Table 5-1. The groundwater in the uppermost aquifer has been affected by past releases associated with the operation of former unlined ponds located beneath and adjacent to the Phase IV ponds. These effects are elevated sulfate and other common ion concentrations with respect to unaffected groundwater in the uppermost aquifer. In addition, arsenic, orthophosphate, fluoride, and nitrate concentrations are elevated as a result of residual constituents released from the old ponds. Residual concentrations are reflected even in upgradient Well 167, where nitrate, arsenic, and orthophosphate are found at concentrations greater than those in unaffected groundwater. Unaffected or background groundwater quality was characterized during the CERCLA remedial investigation for the EMF site.

Potassium was identified as one of the best indicator constituents that would indicate a recent release. Background groundwater contains low potassium concentrations relative to the concentrations in pond water. Potassium is also a very mobile chemical once dissolved in water. Therefore, potassium from old releases has largely migrated through the aquifer system whereas

TABLE 5-1
GROUNDWATER CHEMISTRY – PHASE IV PONDS

	Michaud(1)	Bannock(1)	Well 104(1)			
Analyte	**95% UCL(2)(3)**	**95% UCL(2)(3)**	**2000 Q 1**	**2000 Q 2**	**2000 Q 3**	**2000 Q 4**
Arsenic	0.0157	0.0183	0.0747	0.0722	0.0716	0.0672
Cadmium	0.0025	0.0012	0.001 U	0.001 U	0.001 U	0.001 U
Chloride	212.02	64.06	140 J	134	147	148 J
Fluoride	0.816	0.602	4.9	4.5 J	4.8	4.6 J
Nitrate (NO_3 as N)	4.728	1.944	25.9 J	26.1	26.3	24.5 J
Orthophosphate (PO_4 as P)	0.943	0.631	4.8 J	4.1 J	4.1	3.7
pH	7.90	7.71	7.42	7.48	7.27	7.3
Potassium		11.54	279 J	255 J	260 J	258 J
Selenium	0.0059	0.0030	0.005 U	0.005 U	0.005 U	0.005 U
Specific conductance, at 25°C (μmhos/cm)	1193	762	2250	2310	2140	2160
Sulfate	115.77	125.35	166 J	161	169	165 J
Temperature (°C)	17.00	17.74	13.6	13.9	13.7	13.4
Total Ammonia (NH_3+NH_4 as N)	0.782	0.315	6.3 J	4.7 J	3.5	4
Turbidity (NTU)			0.7	1.4	0.7	0.6

Notes
1) all results in mg/l unless noted — U = Measured Not Detected — J = estimated value
2) 95% UCLs were calculated from all data through 2nd quarter 1998. — U = Qualified Not Detected — R = rejected
3) Source: RCRA Part B Permit Application, Volume 5, Section E, Table E-19, revised 11/23/98.

TABLE 5-1 (CONT'D)

	Michaud[1]	Bannock[1]	Well 114[1]			
Analyte	**95% UCL[2] [3]**	**95% UCL[2] [3]**	**2000 Q 1**	**2000 Q 2**	**2000 Q 3**	**2000 Q 4**
Arsenic	0.0157	0.0183	0.14	0.144	0.14 5	0.143
Cadmium	0.0025	0.0012	0.00083 UJ	0.001 U	0.001 U	0.001 U
Chloride	212.02	64.06	138 J	141	144	142 J
Fluoride	0.816	0.602	0.89	0.86 J	0.88	0.51 J
Nitrate (NO_3 as N)	4.728	1.944	0.07 J	0.1 U	0.1 U	0.1 U
Orthophosphate (PO_4 as P)	0.943	0.631	2.7 J	1.7 J	2.5	2.4
pH	7.90	7.71	7.29	7.36	7.14	7.16
Potassium		11.54	17.7 J	17.1 J	18.9	20.1 J
Selenium	0.0059	0.0030	0.0046 UJ	0.005 U	0.005 U	0.005 U
Specific conductance, at 25°C (μmhos/cm)	1193	762	1636	1649	1627	1653
Sulfate	115.77	125.35	115 J	116	121	119 J
Temperature, (°C)	17.00	17.74	10.6	10.9	10.8	10.6
Total Ammonia (NH_3+NH_4 as N)	0.782	0.315	1.1 J	1.3 J	1.1	1.1
Turbidity (NTU)			0.6	0.8	0.9	1.1

Notes

1) all results in mg/l unless noted — U = Measured Not Detected — J = estimated value

2) 95% UCLs were calculated from all data through 2nd quarter 1998. — U = Qualified Not Detected R = rejected

3) Source: RCRA Part B Permit Application, Volume 5, Section E, Table E-19, revised 11/23/98.

TABLE 5-1 (CONT'D)

	Michaud[1]	Bannock[1]	Well 131[1]			
Analyte	**95% UCL[2] [3]**	**95% UCL[2] [3]**	**2000 Q 1**	**2000 Q 2**	**2000 Q 3**	**2000 Q 4**
Arsenic	0.0157	0.0183	0.0712	0.0669	0.0731	0.0749
Cadmium	0.0025	0.0012	0.00078 UJ	0.001 U	0.001 U	0.001 U
Chloride	212.02	64.06	169 J	169	178	177 J
Fluoride	0.816	0.602	0.1 U	0.1 U	0.14	0.11
Nitrate (NO_3 as N)	4.728	1.944	0.16 J	0.18 J	0.23	0.2 J
Orthophosphate (PO_4 as P)	0.943	0.631	8.2 J	7.5 J	5.7	8.4
pH	7.90	7.71	7.15	7.22	6.98	7.04
Potassium		11.54	15.1 J	13.1	15.6 J	15.5 J
Selenium	0.0059	0.0030	0.0046 U	0.005 U	0.005 U	0.005 U
Specific conductance, at 25 C (μmhos/cm)	1193	762	1644	1654	1638	1665
Sulfate	115.77	125.35	146 J	139	150	151 J
Temperature, (°C)	17.00	17.74	13.3	13.5	13.4	13
Total Ammonia (NH_3+NH_4 as N)	0.782	0.315	0.3 J	0.2 UJ	0.2 U	0.2 U
Turbidity (NTU)			40.9	24	82	78

Notes

1) all results in mg/l unless noted — U = Measured Not Detected — J = estimated value

2) 95% UCLs were calculated from all data through 2nd quarter 1998. — U = Qualified Not Detected — R = rejected

3) Source: RCRA Part B Permit Application, Volume 5, Section E, Table E-19, revised 11/23/98.

TABLE 5-1 (CONT'D)

	Michaud[1]	Bannock[1]	Well 167[1]			
Analyte	**95% UCL[2] [3]**	**95% UCL[2] [3]**	**2000 Q 1**	**2000 Q 2**	**2000 Q 3**	**2000 Q 4**
Arsenic	0.0157	0.0183	0.0609	0.0523	0.0577	0.0575
Cadmium	0.0025	0.0012	0.00094 UJ	0.0001 U	0.0001 U	0.0001 U
Chloride	212.02	64.06	128 J	120	124	134 J
Fluoride	0.816	0.602	0.2 UJ	0.1 U	0.1 U	0.1 U
Nitrate (NO_3 as N)	4.728	1.944	3.9 J	4	5.7	2.3 J
Orthophosphate (PO_4 as P)	0.943	0.631	11.3 J	10.9 J	9.4	11.9
pH	7.90	7.71	7.1	7.17	7	6.99
Potassium		11.54	16.1 J	14.2	16.1	15.4 J
Selenium	0.0059	0.0030	0.0048 UJ	0.005 U	0.005 U	0.005 U
Specific conductance, at 25 C (μmhos/cm)	1193	762	1497	1510	1504	1481
Sulfate	115.77	125.35	129 J	123	138	131 J
Temperature, (°C)	17.00	17.74	14.4	14.2	14.3	13.9
Total Ammonia (NH_3+NH_4 as N)	0.782	0.315	0.2 UJ	0.2 UJ	0.2 U	0.2 U
Turbidity (NTU)			0.3	2.2	1.6	1.5

Notes

1) all results in mg/l unless noted — U = Measured Not Detected — J = estimated value

2) 95% UCLs were calculated from all data through 2nd quarter 1998. — U = Qualified Not Detected — R = rejected

3) Source: RCRA Part B Permit Application, Volume 5, Section E, Table E-19, revised 11/23/98.

TABLE 5-1 (CONT'D)

	Michaud[1]	Bannock[1]	Well 168[1]			
Analyte	**95% UCL[2][3]**	**95% UCL[2][3]**	**2000 Q 1**	**2000 Q 2**	**2000 Q 3**	**2000 Q 4**
Arsenic	0.0157	0.0183	0.0317	0.0272	0.0304	0.031
Cadmium	0.0025	0.0012	0.00098 UJ	0.001 U	0.001 U	0.001 U
Chloride	212.02	64.06	129 J	132	145	141 J
Fluoride	0.816	0.602	5.5	4.6 U	5.5	5.3 J
Nitrate (NO_3 as N)	4.728	1.944	14.7 J	16.3	17.2	16.2 J
Orthophosphate (PO_4 as P)	0.943	0.631	0.5 U	0.56 UJ	0.39 UJ	0.63 UJ
pH	7.90	7.71	7.28	7.33	7.09	7.15
Potassium		11.54	17.7 J	15.6	16.6 J	15.7 J
Selenium	0.0059	0.0030	0.0179	0.0152	0.013	0.0158
Specific conductance, at 25 C (μmhos/cm)	1193	762	2290	2400	2280	2300
Sulfate	115.77	125.35	704 J	725	721	687 J
Temperature, (°C)	17.00	17.74	12.4	12.7	13.3	11.7
Total Ammonia (NH_3+NH_4 as N)	0.782	0.315	0.7 J	0.5 J	0.4	0.4
Turbidity (NTU)			19.1	6	1.4	1

Notes
1) all results in mg/l unless noted — U = Measured Not Detected — J = estimated value
2) 95% UCLs were calculated from all data through 2nd quarter 1998. — U = Qualified Not Detected — R = rejected
3) Source: RCRA Part B Permit Application, Volume 5, Section E, Table E-19, revised 11/23/98.

other chemicals are still migrating into the groundwater because of lower mobility. These characteristics make increasing potassium concentrations a good indicator of any recent leaks from the Phase IV ponds.

The RCRA groundwater monitoring data for 2000 show that potassium concentrations are near background levels in Wells 114, 131, 167, and 168. Initially, potassium concentrations were much greater in Well 168, but this can be attributed to the highly turbid water samples yielded by the well after installation. Successive sampling events show decreasing turbidity and corresponding decreases in potassium concentrations.

Well 104 continues to show elevated potassium concentrations; however, this well is within the area influenced by mounding from former Pond 8S (WMU #7). Pond 8S was an unlined pond that has impacted groundwater.

The data from the RCRA groundwater monitoring system have been analyzed and reported on an annual basis since 1993. The results of the statistical analyses performed as part of these evaluations indicate the Phase IV ponds are not leaking. These conclusions are supported by the analyses performed on the 2000 data presented in Table 5-1 (Astaris 2001a). Groundwater chemical data in the form of time series plots and the statistical tests are presented in Appendix F.

6 Closure Plan Description

Closure Plan Description

The planned closure activities for the Phase IV ponds are summarized in Section 6.1. The rationale for the closure is based on the performance standards discussed in Section 6.2. Section 6.3 contains performance standards for the decontamination of materials and equipment. The decontamination and closure activities will be conducted in accordance with the Health and Safety Plan, as indicated in Section 6.4. Sampling and analysis procedures during the closure activities are addressed in Section 6.5. The closure schedule is described in Section 6.6, and amendments to the closure plan (if necessary) are addressed in Section 6.7.

6.1 PLAN SUMMARY DESCRIPTION

The Phase IV ponds will be closed with waste in place as a RCRA hazardous waste landfill, which includes placing a final cover over the unit. The objective of the closure is to reduce and control potential migration of waste constituents from the pond solids into the groundwater or surrounding soils. Any contaminated surface or subsurface soils within the limits of the final cap will be contained under the cap.

FMC proposes to use the cap design presented in this closure plan, which is the same closure cap design as that for Pond 8S (FMC 1998a). The Pond 8S final cap was approved by EPA and installed during the 1999 construction season. The final cap for the Phase IV ponds will be placed over the top of the dikes of the ponds, as described in Section 7. The design presented for this closure plan includes information and experience gained from closure activities which were conducted at Pond 8S.

Closure of the Phase IV ponds will be implemented in accordance with applicable requirements of RCRA in 40 C.F.R. Part 265. The closure procedures are described in detail in Section 8. After notifying and obtaining concurrence from EPA, the following initial closure activities have been conducted at the unit:

- Installed geofabric over the pond solids in each pond to separate the initial fill and pond solids, concurrent with the installation of a perforated pipe drainage system for dewatering the ponds during backfilling and consolidation.
- Placed sand backfill using conveyor equipment to prevent exposure of pond solids to the atmosphere as water was being pumped using portable pumps. Water pumped from the ponds during the backfill process was sent to an onsite RCRA MTR surface impoundment for ultimate recycle back into plant processes.

- Placed additional granular backfill and geoweb panels in the ponds as needed to stabilize the backfill, and to provide working platforms over each pond area.

- Installed wick drains in Ponds 11S and 12S upon completion of sand backfill, to improve drainage and accelerate consolidation of the pond solids. Due to the relative shallow depth of sludge in Ponds 13S and 14S, no wick drains were installed in these ponds.

- Backfilled the pond areas with slag up to the subgrade surface level. Rough graded and installed temporary settlement monitoring plates on the subgrade. Installed a temporary cover on the subgrade surface to minimize precipitation infiltration into the fill.

- Installed temporary pumping systems to remove water from the Ponds 11S, 12S, and 13S to accelerate their consolidation. As anticipated, due to the relatively shallow depth of sludge in Pond 14S, after free surface water removal during initial filling activities, field testing of the installed drainage piping system indicated that a dewatering pumping system was not required for this pond.

Current closure activities being conducted are:

- Monitoring subgrade settlement until the settlement rate has diminished to an acceptable level.

- Any additional water that needs to be removed will be pumped to a new on-site water treatment plant or managed in accordance with RCRA requirements.

The remaining closure activities are as follows:

- After completion of pumping, flush and remove all surface piping within the closure area. Decontaminate and/or dispose of any structures or equipment associated with these pipes, as described in Section 6.3.

- Mobilize the contractor, remove and dispose of the temporary cover, regrade the subgrade, place the final cover, install temperature, pressure, and drainage monitoring systems, install settlement monuments, certify closure as discussed in Section 8.11, and demobilize the contractor.

- Place barriers and warning signs around the closure area according to Section 10.2, complete and submit an as-built survey plat, and record land use restrictions on the property deed (40 C.F.R. §265.116 and 265.119).

- Initiate post-closure monitoring in accordance with 40 C.F.R. §265.117, as outlined in Section 10.

Closure and post-closure cost estimates and financial assurance demonstrations are presented in Sections 11 and 12, respectively.

6.2 CLOSURE RATIONALE AND PERFORMANCE STANDARDS

6.2.1 Closure Rationale

The Closure Plan calls for closure of the Phase IV ponds by capping. The objective of the plan is to reduce and control potential migration of waste constituents into the groundwater or the surrounding soils. Before capping the pond solids, any underground pipes outside the dike area but within the limits of the closure area will either be removed for disposal or plugged and capped in place, as described in Subsection 8.3.

Capping of the Phase IV ponds is proposed to control infiltration of rain water into the waste (pond solids). This will minimize migration of constituents from pond solids into groundwater or subsoil. Waste migration into surface waters will also be prevented by capping as it will minimize chances of contaminated precipitation runoff. Any contaminated surface soils within the limits of the final cap (LFC) will be contained under the cap.

6.2.2 Closure Performance Standards

The proposed closure will be implemented in accordance with the RCRA interim status requirements specified in 40 C.F.R. Part 265, Subparts G (Closure and Post-Closure) and K (Surface Impoundments).

The general closure requirements of Subpart G contain closure performance standards (40 C.F.R. §265.111) which require that the facility be closed in a manner that:

(a) ***Minimizes the need for further maintenance.***

(b) ***Controls, minimizes, or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or to the atmosphere.***

Closure with waste in place, as described in Sections 7 and 8, and post-closure activities, as discussed in Section 10, will achieve the above objectives.

The closure performance requirements for surface impoundments in Subpart K (40 C.F.R. §265.228(a)(2)) require the following for closing a surface impoundment as a hazardous waste landfill:

(i) ***Eliminate free liquids by removing liquid wastes.***

As described in Section 8.2, free liquids (wastewater) were removed during initial fill activities. Dewatering of the unit will continue as needed to ensure that initial fill settlement diminishes to acceptable levels prior to placing the final cap.

(ii) ***Stabilize remaining wastes to a bearing capacity sufficient to support the final cover.***

As described in Section 8.6, pond solids at each pond will be stabilized by consolidation under the weight of the sand and slag backfill. In addition, for Ponds 11S and 12S, the presence of wick drains will accelerate the consolidation period. The backfill provides a working platform for the subgrade, which will support the final cover.

(iii) ***Cover the surface impoundment with a final cover designed and constructed to: (A) Provide long-term minimization of the migration of liquids through the closed impoundment, (B) Function with minimum maintenance, (C) Promote drainage and minimize erosion or abrasion of the cover, (D) Accommodate settling and subsidence so that the cover's integrity is maintained, and (E) Have a permeability less than or equal to the permeability of any bottom liner or natural subsoils present.***

The closure cap proposed for the unit is designed to conform to the above standards. The design components of the cap are described in Section 7 of this closure plan.

To ensure the closed unit meets or exceeds all design criteria and specifications outlined in this closure plan, a construction quality assurance (CQA) program (included in Appendix I) will be implemented in accordance with 40 C.F.R. §265.19. After installation of the cap, the closure area will be monitored for a period of 30 years, unless shortened or lengthened by the Regional Administrator in accordance with 40 C.F.R. §265.117. During the post-closure care period, FMC will perform the post-closure monitoring activities required by 40 C.F.R. §§265.117, 265.228(b), and 265.310, as described in Section 10 of the closure plan.

6.3 MATERIALS/EQUIPMENT DECONTAMINATION

The waste streams received by the Phase IV ponds have included characteristic hazardous wastes. Therefore, any equipment or salvageable material that comes into contact with wastes in the Phase IV ponds during closure activities could be contaminated with residues that are potentially hazardous. All such materials and equipment will be decontaminated prior to being reused, salvaged, or disposed. Initial decontamination will involve rinsing with water and, if necessary, industrial phosphate-free detergent, to safely remove any elemental phosphorus. Once the phosphorus has been removed, decontamination will continue to remove any hazardous waste residues. All waste materials that are clean will be disposed of in accordance with applicable RCRA regulations.

This closure plan proposes the treatment standards contained in the hazardous debris rule (codified in 40 C.F.R. §268.45) for decontaminating materials and equipment. FMC recognizes that these regulations technically are applicable only to debris that is a hazardous waste destined for disposal. Much of the materials and equipment that will be decontaminated are not destined for disposal and their contaminants may not be hazardous. Therefore, the hazardous debris regulation is, by its terms, not applicable to all the decontamination activities associated with this closure plan. However, the treatment standards contained in the debris rule are being proposed as an appropriate set of guidelines for effectively decontaminating materials and equipment.

Materials and equipment will be decontaminated using a combination of the extraction technologies included in Table 1 of 40 C.F.R. §268.45. It is anticipated one or more of the appropriate extraction technologies outlined in this table will be used during the decontamination process. Details of the specific technologies most likely to be used for each type of material/equipment are outlined in Section 8.3.

All residues removed from the materials/equipment and the decontamination washwater will be disposed of in accordance with applicable regulatory requirements. The liquid wastes anticipated are the existing water in the unit, the washwater from equipment decontamination, and water accumulated during pond consolidation.

To verify the effectiveness of decontamination, surfaces of the decontaminated materials/equipment will be visually inspected to confirm the absence of any significant amount of residual contamination. The performance standard to be used for all materials/equipment will be the "clean debris surface" criteria, defined in Footnote 3 Table 1, 40 C.F.R. §268.45. In addition, samples of the final rinsate will be analyzed to verify the effectiveness of decontamination. The rinsate samples will be analyzed for RCRA metals using the TCLP method and for total phosphorus. Equipment will be considered decontaminated if they have a clean surface and there is no visual observation of elemental phosphorus (P_4) as indicated by smoke or fire. Sampling and analysis procedures will be performed in accordance with the "Field Sampling Plan for Equipment Decontamination Confirmation During RCRA Pond Closures" contained in Appendix E of this closure plan. The laboratory QAPP is maintained in the laboratory and at the FMC facility. A copy of the QAPP is also found in Volume 1.1, Appendix C-5 of FMC's RCRA Part B Permit Application, November 23, 1998 (FMC 1997b).

6.4 HEALTH AND SAFETY PLAN

To conduct the approved CERCLA RI/FS Work Plan activities at the FMC facility, a Health and Safety Plan (Bechtel 1992a) was developed for the site in February 1992 using the guidelines established by NIOSH/OSHA/EPA. This plan is designated here as the RI/FS Health and Safety Plan or the RI-H&S Plan. On the basis of the RI-H&S Plan, a Health and Safety Plan has been developed specific to the proposed Phase IV ponds closure activities. It is designated here as the "Task-Specific Health and Safety Plan for Phase IV Ponds Closure Activities" (H&S Plan), which is submitted in Appendix G of this Closure Plan.

6.5 SAMPLING AND ANALYSIS PLANS

One Quality Assurance Project Plan (QAPjP) and two companion Field Sampling Plans (FSPs) that constitute two Sampling and Analysis Plans (SAPs) (Attachment 10, Section 10) have been developed for WMU closure and post-closure activities. A SAP includes a Quality Assurance Project Plan (QAPjP) and a Field Sampling Plan (FSP). A QAPjP for post-closure groundwater monitoring and temperature, pressure, and gas monitoring is included in Attachment 10-1. A FSP for groundwater monitoring is included in Attachment 10-2a. A FSP for temperature, pressure, and gas monitoring is included in Attachment 10-2b. The SAPs have been developed to be consistent with the following EPA guidance documents: *Test Methods for Evaluating Solid Waste, SW-846, Rev. 3 (EPA 1996); EPA Guidance for Quality Assurance Project Plans (EPA QA/G-5, February 1998); EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5, March 2002); and Standard Operating Procedures and Quality Assurance Manual (EPA 1991a).*

6.6 SCHEDULE

Closure has commenced at the Phase IV ponds conforming to the time and manner specified in 40 C.F.R. §265.113(a), following the closure schedule outlined in Table 6-1. Detailed design, and field activities associated with the installation of the initial fill were carried out as outlined in Section 8 after EPA approved this work. As shown in Table 6-1, the proposed Phase IV ponds closure activities will of necessity extend beyond 180 days from the initiation of closure.

TABLE 6-1
PROPOSED SCHEDULE FOR PHASE IV PONDS CLOSURE ACTIVITIES
FMC - POCATELLO, IDAHO

Closure Activity	Duration (Days)
Detail design of initial fill and procurement	Completed
Mobilize; pump phossy water out of unit while placing backfill to develop working platform(1)	Completed
Backfill initial sand and slag over the ponds and stabilize the working platforms(1)	Completed
Place the subgrade and install the permanent dewatering system, temporary cover and temporary settlement plates(1)	Completed (2)
Operation of dewatering system, settlement monitoring and periodic settlement reports	Pond Solids Consolidation period(3)
Final cap design and procurement	0(4) - 120(4)
Acceptable settlement rate achieved	120(4)
Backfill and grade to compensate for the settlement	120(4) - 155(4)
Install the RCRA cap and settlement monuments	155(4), (5) - 300(4), (5)
Submit certification	360(6)

(1) Activities started after receipt of EPA approval.

(2) Pond 11S was completed on 10/21/99, Pond 12S on 10/24/99, Pond 13S on 10/19/99, and Pond 14S on 9/30/99.

(3) Period required for subgrade settlement rate to diminish to the acceptable level of 1 inch per year after completion of initial fill, as described in detail in Section 7.4.5.

(4) All final cap activities are based on the start of final cap design, which is assumed to commence 120 days prior to subgrade settlement rate diminishing to the acceptable level of 1 inch per year. Also assumes that the construction of the final cap can be completed within the same year's construction season prior to onset of inclement winter weather. Should the required settlement period extend beyond this period, all final cap closure activities will be delayed accordingly.

(5) Activity to be completed once a final cap detail design package is developed and is approved by the EPA, and the construction subcontract is secured.

(6) Closure certification will be submitted within 60 days after completion of closure.

The time required for initial fill placement and settlement of pond solids to acceptable rates for final cap installation (1 inch in 1 year) will of necessity exceed 180 days. Also, the construction season is influenced by the potential for severe weather at the site, resulting in the possible delay of field implementation of pond closure during the winter months.

Pond backfilling and installation of the temporary covers and temporary settlement monuments was completed September 30, 1999 for Pond 14S, October 19, 1999 for Pond 13S, October 24, 1999 for Pond 12S, and October 21, 1999 for Pond 11S. As discussed in Section 7.4.5, settlement due to the consolidation of the underlying pond solids is expected to reach an acceptable level for final cap construction (i.e., 1 inch in 1 year) during the second or possibly the third year after placement of the initial sand and slag fill. The settlement rates have been and will continue to be monitored until they reach acceptable levels so that the subgrade can adequately receive and support the final cap.

The final cap construction must be performed during the construction season and depends on receipt of EPA approval. Therefore, FMC will review the schedule to finalize the specific calendar days for the closure activities, notify EPA, and proceed with the closure as planned.

6.6.1 Request for the Extension of the 180-Day Closure Period

As outlined above, closure activities at the Phase IV ponds will, of necessity, require longer than the regulatory allowance of 180 days specified by 40 C.F.R. §265.113(b). This Closure Plan serves as a request for EPA approval on the extended closure period required for the Phase IV ponds, based on the above-specified reasons and in accordance with 40 C.F.R. §265.113(b)(1)(i). Approval of this Closure Plan will be assumed to constitute approval of the request for extension. Until the final cap is installed, FMC will continue to monitor these ponds and will take all steps to prevent threats to human health and the environment from this unit, including compliance with all applicable interim status requirements, per 40 C.F.R. §265.113(b)(2).

6.7 CLOSURE PLAN AMENDMENTS

The Phase IV Ponds Closure Plan will be amended in accordance with the requirements of 40 C.F.R. §270.42 whenever:

- Changes in operations affect the Closure Plan, or
- Schedule revisions cause a change in the expected year of closure, or
- Unexpected events during the closure activities require modifications to the closure plan, or
- Changes in governing regulations occur.

Any necessary amendments will be submitted to EPA Region 10 at least 60 days prior to changes in operations, or within 60 days after any unexpected event during closure activities that affects the closure plan

Closure Design Considerations

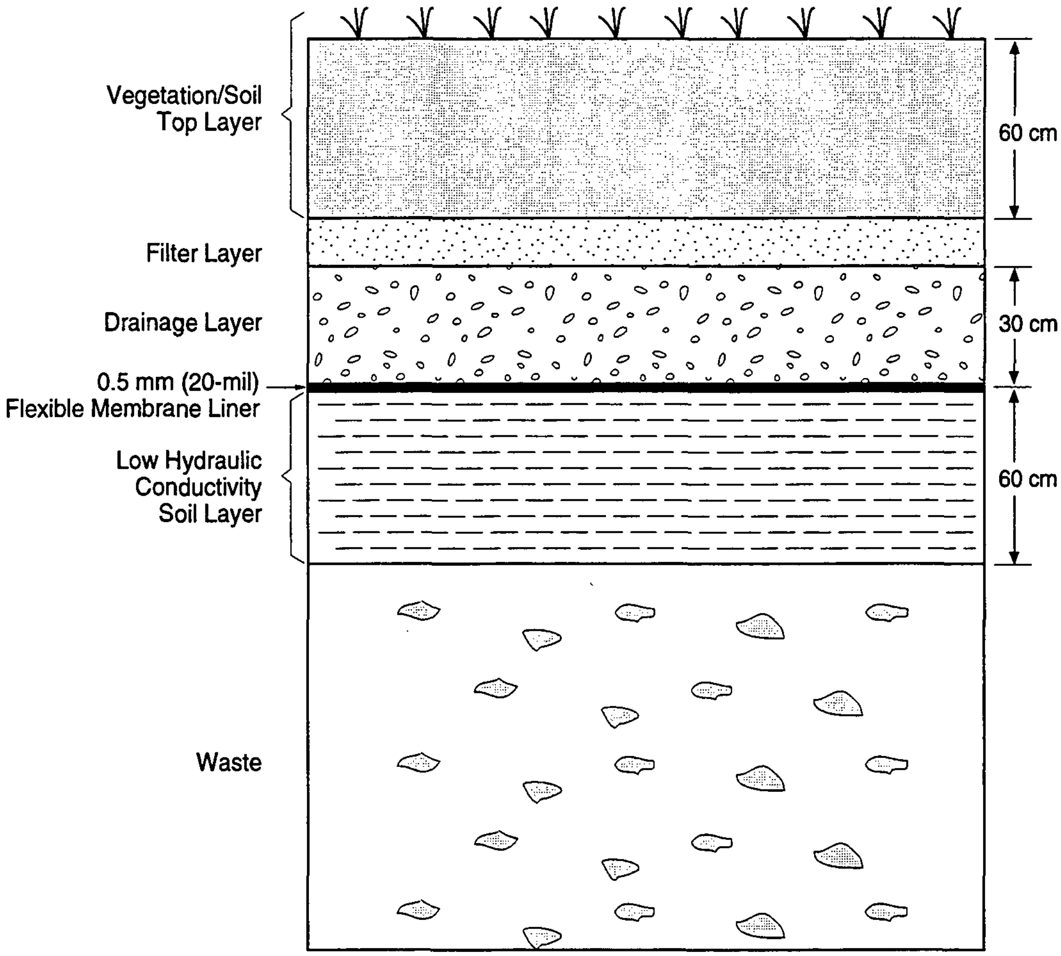
This section presents the requirements and parameters considered for the design of the RCRA cap proposed for the Phase IV ponds closure. The rationale for the proposed capping and the related performance standards are described in Section 6.2. The design requirements for the proposed cap are described in Section 7.1.1, and the design basis for cap installation is presented in Sections 7.1.1 through 7.1.4. The various components of the proposed cap and cap grading are discussed in Sections 7.2 and 7.3, respectively. The anticipated settlement, slope stability of the dikes, and storm water management for the Phase IV ponds closure area are presented in Sections 7.4 through 7.6. Section 7.7 describes the stability of the final cover and cover erosion.

7.1 DESIGN REQUIREMENTS

The following sections discuss the design basis for the final cap proposed for the Phase IV ponds. The objective of the final cap is to minimize infiltration of precipitation through the cap after closure. The EPA-recommended minimum cap (or RCRA guidance cap) (EPA 1991b) as described in Section 7.1.1, was used in a computer analysis (Section 7.1.2) to determine the infiltration rate through such a cap. The proposed Phase IV ponds RCRA cap design was then developed to account for other engineering considerations as well as site-specific conditions. Equivalent engineered synthetic materials were substituted for the drainage layer and the low hydraulic conductivity layer. At the same time, the thickness of the cover layer was increased to provide protection for the low hydraulic conductivity layer against frost penetration. A computer analysis was then performed to demonstrate equivalency in the infiltration rate through the proposed Phase IV ponds RCRA cap versus the RCRA guidance cap.

7.1.1 RCRA Cap Requirements

The EPA-recommended requirements for a RCRA guidance cap were obtained from the EPA publication for the design and construction of RCRA final covers (EPA 1991b). These requirements are shown schematically in Figure 7-1 and outlined below.



Source: U.S. EPA, 1991a

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO, LLC POCATELLO, IDAHO			
RCRA-guidance Cap			
	Job No.	Drawing No.	Rev.
	24230	Figure 7-1	1

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The minimum-recommended thickness for each component of the RCRA guidance cap are listed in descending order from the top of the cap down to the top of the waste.

(A)	60 cm (2 feet)	Vegetation/soil top layer
(B)	-----	Filter layer
(C)	30 cm (1 foot)	Drainage layer
(D)	0.5 mm (20-mil)	Flexible membrane liner
(E)	60 cm (2 feet)	Low hydraulic conductivity soil layer
(F)	----	Waste

For infiltration rate analysis purposes, the above requirements for a RCRA guidance cap were further defined as follows to incorporate specific engineering and material selections. Components of the RCRA guidance cap are listed in descending order from the top of the cap down to the waste:

(A) 60 cm (2 feet) — Protective Cap Cover (vegetation/soil top layer): Grass cover over the topsoil classified as ML/SM per ASTM Standard D2487, and slag and coarse sand classified as SP or GW per ASTM D2487; poor grass coverage was selected, considering the site climatic conditions.

(B) ---------- — Filter Layer: Geofabric, a commercial synthetic filter fabric.

(C) 30 cm (1 foot) — Drainage Layer: Granular layer of sand or pea gravel with a maximum size of 1 inch, classified as SP/GP per ASTM Standard D2487; and having a hydraulic conductivity of 10^{-2} cm/sec or higher.

(D) 0.5 mm (20-mil) — Geomembrane: Durable commercial synthetic liner, High-Density Polyethylene (HDPE) or equivalent.

(E) 60 cm (2 feet) — Low Hydraulic Conductivity Layer: Class I clay soil, classified as CL per the Unified Soil Classification System (ASTM Standard D2487), having a hydraulic conductivity of 10^{-7} cm/sec or less.

7.1.2 Infiltration Rate Analysis

A computer model was used to determine the infiltration rate of precipitation through the RCRA guidance cap (as defined in Section 7.1.1, Figure 7-1), and the proposed Phase IV ponds RCRA cap (as defined below and as shown in Figure 7-2).

To evaluate the performance of the engineered RCRA guidance cap and the proposed RCRA cap, percolation rates through the bottom of the cap were estimated using the Hydrologic Evaluation of Landfill Performance (HELP) computer program (EPA, 1994a and 1994b) and the UNSAT-H computer program (Fayer and Jones, 1990). The performance of the RCRA guidance cap versus the proposed Phase IV ponds RCRA cap were evaluated by comparing the net infiltration rates through the bottom of each cap.

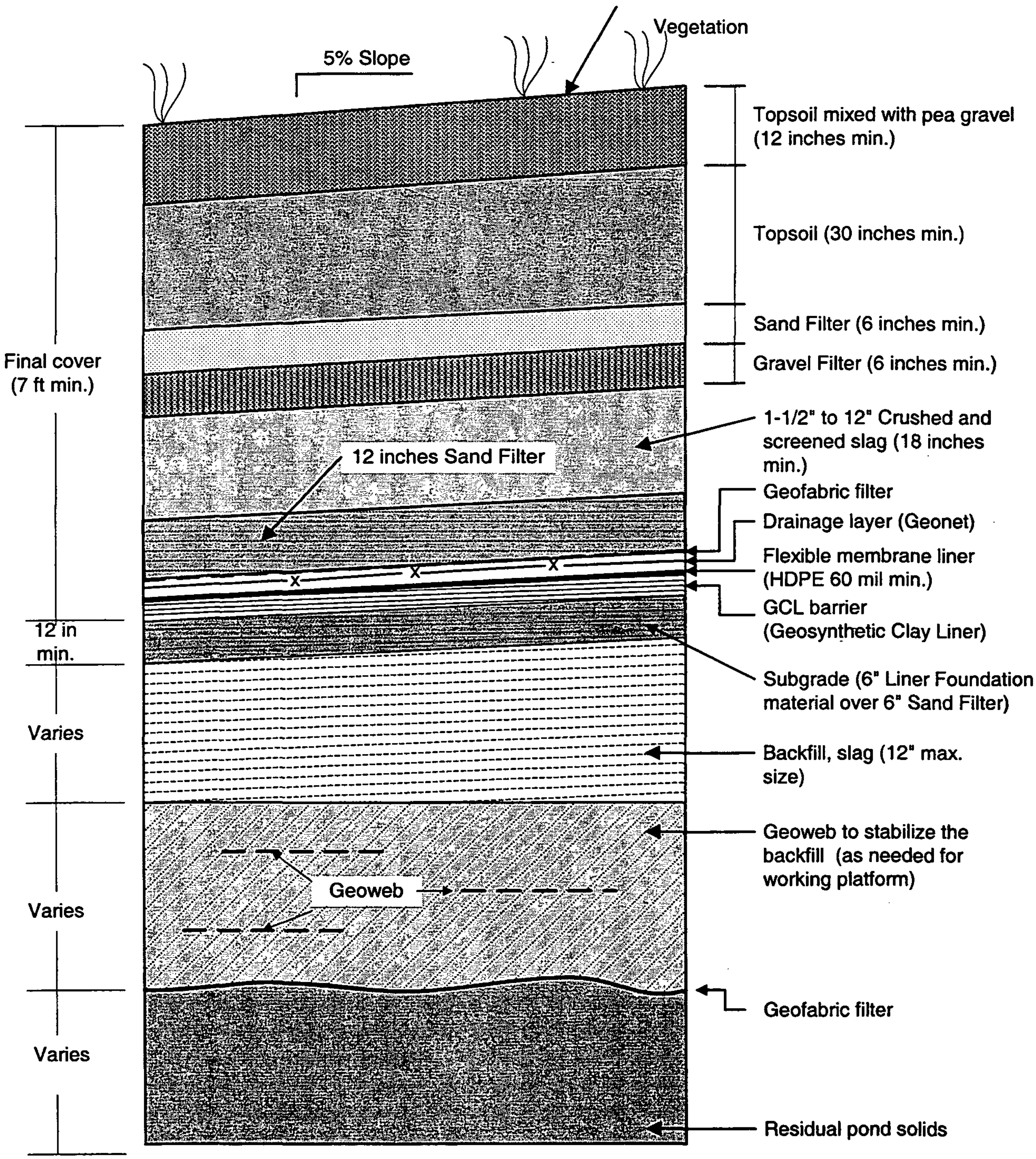
The HELP model was run on the RCRA guidance cap to establish the infiltration rate through the EPA guidance cap as specified in 40 C.F.R. §§264.111 and 264.228. The RCRA guidance cap was then modified by providing adequate cover for frost protection and substituting geonet and geosynthetic clay liner for the soil drainage layer and compacted clay soil low-permeability layer, respectively.

To meet the EPA requirements for a long functional life, long-term minimization of migration of liquids through the cap, minimizing the potential of biointrusion through the cap, promoting drainage and minimizing erosion or abrasion of the cover, the proposed Phase IV ponds RCRA cap was further modified. The various layers of this modified proposed RCRA cap are as follows:

A) 210 cm (7 feet) Protective Cap Cover (vegetation/soil/slag top layers):

- Grass cover over 105 cm (3.5 feet) of topsoil classified as ML/SM per ASTM Standard D2487 with the top 30 cm (12 inches) of topsoil mixed with pea gravel; poor grass coverage was selected considering the site climatic conditions.

- 15 cm (6 inches) of sand and 15 cm (6 inches) of gravel transition (filter) layers,



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Typical Section of Phase IV Ponds Cap and Subgrade		
Job No.	Drawing No.	Rev.
24230	Figure 7-2	2

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- 45 cm (18 inches) of coarse slag classified as SP or GW per ASTM Standard D2487;

- 30 cm (12 inches) of sand all classified as SP or GW per ASTM Standard D2487;

B)	----------	Filter Layer: Filter fabric, a commercial synthetic filter fabric.
C)	----------	Drainage Layer: Geonet (GN) drainage layer, a commercial synthetic drainage net, having a performance equivalent to a one-foot thick layer of granular material which has a hydraulic conductivity of 10^{-2} cm/sec or higher.
D)	1.5 mm (60-mil)	Geomembrane: Durable commercial synthetic liner, HDPE.
E)	----------	Equivalent Low Hydraulic Conductivity Layer: Geosynthetic Clay Liner (GCL), a commercial synthetic HDPE/Bentonite composite liner, having a hydraulic conductivity of 5x 10^{-9} cm/sec or less, hydraulically equivalent to a 2-foot thick layer of fine clayey material with a hydraulic conductivity of 1 x 10^{-7} cm/sec.

The 3.5 feet (42-inch) thick topsoil layer serves several important purposes:

- provides a storage medium for the retention of infiltrating water and its subsequent removal by evapotranspiration, and

- allows for the natural growth of a vegetative cover which will enhance the removal of moisture from the soil and decrease wind and water erosion.

The upper 12 inches of the topsoil incorporates 15% by weight pea gravel which will serve to stabilize the cap surface and hence reduce erosion losses.

Graded filter material consisting of 6 inches of coarse sand and 6 inches of 4-inch minus graded crushed and screened slag or gravel. This two-layer graded filter will prevent the overlying fine-textured soil from moving downward and accumulating in the coarse slag layer and/or the geofabric above the lateral drainage layer. This will assure the continued functionality of the capillary barrier.

The 18 inches of crushed and screened coarse slag will control biointrusion and will present an obstacle to inadvertent human intrusion.

The 12 inches of coarse sand to be placed underneath the coarse slag biointrusion layer will protect the underlying synthetic materials.

The drainage layer of geofabric and geosynthetic drainage net, and the underlying layers of 60-mil HDPE liner over GCL low hydraulic conductivity layer will form the secondary barrier of the Phase IV ponds cap.

In effect, the modified cap consists of two main components:

- A capillary barrier comprised of the topsoil, the graded filter material and the biointrusion layer. The purpose of the capillary barrier in semi-arid climates such as that present in Pocatello is to limit the rate of infiltration through the cap and to ensure the longevity of the cap.
- A secondary barrier underlying the capillary barrier comprised of the drainage layer and the synthetic liners. The purpose of the secondary barrier is to act as a contingency barrier that will further decrease the net infiltration into the waste area by allowing for the lateral drainage of the excess infiltration through the capillary barrier.

The HELP model is recommended by EPA to evaluate the hydrologic performance of surface barrier designs. However, the application of the HELP model to the proposed closure cap has two major limitations. First, the HELP model assumes a time invariant evaporative zone depth which may not be a valid assumption for semi-arid climates similar to that at Pocatello. Second, the equations used in the HELP model to simulate flow in the unsaturated zone cannot accurately model flow through the capillary barrier proposed for the Phase IV ponds. On the other hand, the computer code UNSAT-H is capable of simulating flow through a barrier layer, however does not account for any lateral drainage from the cap and cannot simulate flow through the FML. To overcome the limitations of each of these two programs, the hydrological performance of the proposed cap was evaluated in two steps. In the first step, flow through the capillary barrier (i.e., topsoil to the sand foundation layer underneath the coarse slag, biointrusion layer) was simulated with the UNSAT-H computer program. In the second step of the analysis, the HELP program was used to simulate flow through the secondary cap underneath the barrier cap (sand to the GCL). In this latter step, the daily percolation through to the bottom of the capillary cap resulting from the UNSAT-H analysis was incorporated into the HELP model input.

In addition to the approach presented above, the proposed cap was also modeled in its entirety with the HELP model for comparison purposes. Furthermore, to demonstrate the equivalency of the proposed Phase IV ponds RCRA cap to the RCRA guidance cap, the RCRA guidance cap was also evaluated using the HELP model. Climatological data for the UNSAT-H and the HELP programs consist of daily rainfall, temperature, and solar radiation data. Because the length of the climatological data records is much shorter than the 500-year functional life of the proposed cap, daily rainfall, temperature and solar radiation data were synthetically generated. The routine used to generate the climatological data was developed by the USDA Agricultural Research Service (Richardson and Wright, 1984) and is described in the HELP manual (EPA, 1994b). The generating procedure is designed to preserve the dependence in time, the correlation between variables and the seasonal characteristics of the actual weather data at the specified locations. The 500-year synthetic data were generated by estimating first the statistical rainfall distribution data at the site from rainfall data recorded at the Pocatello Municipal Airport (National Weather Service Station No. 24156) for the period 1948 to 1991. A summary of these data is provided in the estimated infiltration rates report (Appendix H).

The soil parameters for each component of the proposed RCRA cap are described below. Note that the geofabric was not incorporated in the model because it does not influence flow through the cap. The UNSAT-H model requires the input of the Van Genuchten parameters which define the soil's characteristic curves (i.e., the variation of soil's hydraulic conductivity as a function of its moisture content). On the other hand, the definition of the field capacity and the wilting point are required in the HELP model. In general, these latter two parameters were set equal to default HELP values found in the HELP documentation (Table 4, EPA, 1994b) for comparable materials. Where applicable, the hydraulic conductivity values were assigned conservative values when selecting between HELP default values and the technical specifications included in Appendix I, thus leading to higher percolation rates. The hydraulic conductivities assigned to each material are as follows:

- Topsoil: The hydraulic conductivity of the topsoil was set at 9.35×10^{-4} cm/s, which is approximately two times the HELP default value for sand-silt mixtures. The Van Genuchten parameters used in the UNSAT-H model to define the characteristic curves (variation of hydraulic conductivity as a function of degree of saturation) of the topsoil were based on published literature values for comparable soils (Carsel and Parrish, 1988). Laboratory testing conducted on the locally available soils that will be used for this layer indicate that the above parameter values are conservative.

- Sand Filter (Transition): The saturated hydraulic conductivity, porosity, field capacity and wilting point values used in the numerical model were set to the default HELP values for coarse sand. The Van Genuchten parameters used for this layer were set equal to the suggested values for sand (Carsel and Parrish, 1988).

- Gravel Filter (Transition): The saturated hydraulic conductivity was set to 0.1 cm/s. The Van Genuchten parameters were based on the values used for the engineered barrier study at the 200 Area at Hanford, Washington (Appendix C, DOE, 1996). Default HELP values were used for the porosity, field capacity, and wilting point.

- Coarse Slag: The hydraulic conductivity of this layer was assumed to be 1 cm/s, one order of magnitude greater than that of the gravel filter layer. The van Genuchten parameters were set equal to the values used for the biointrusion layer of the engineered surface barrier at the 200 Area at Hanford, Washington (Appendix C, DOE, 1996).

- Sand: The hydraulic conductivity was assumed to be identical to that of the sand filter material.

- Geonet: The hydraulic conductivity of the geonet was conservatively set equal to 10 cm/s. The technical specification stipulates a transmissivity of 0.001 m^2/s, corresponding to a saturated hydraulic conductivity of 20 cm/s.

- HDPE Geomembrane: The hydraulic conductivity of the HDPE was set equal to 2×10^{-12} cm/s, the typical minimum value of commercially available HDPE liner material, which is more conservative than the HELP default value of 3×10^{-13} cm/s. The placement quality of the FML was assumed to be good. Because the design life of the cap is quite long, the pinhole density was assumed to be "poor" on a scale ranging from "excellent" to "poor", which corresponds to 10 holes/acre.

- Geosynthetic Clay Liner (GCL): The hydraulic conductivity of the GCL was set equal to the HELP default value of a bentonite mat (3×10^{-9} cm/s).

The above parameters were then used in the computer models to predict the infiltration rates. A summary of these data and other parameters are provided in the estimated infiltration rates report (Appendix H).

The comparative results of both the engineered RCRA guidance cap and the proposed RCRA cap are summarized in Table 7-1.

TABLE 7-1
MODELING RESULTS FOR THE PROPOSED AND GUIDANCE CAPS

Cap	Modeling Approach	Runoff (in/yr)	Evapotranspiration (in/yr)	Lateral Drainage (in/yr)	Percolation (in/yr)
Proposed Cap[1]	UNSAT-H/HELP	-	11.62	0.05	8×10^{-6}
	HELP	-	6.98	4.69	2×10^{-5}
EPA Guidance Cap[2]	HELP	-	11.23	.17	11×10^{-5}

[1] Simulated for 500 years
[2] Simulated for 44 years

As illustrated in the summary data found in Table 7-1, the HELP and UNSAT-H/HELP simulations show negligible infiltration rates through the proposed cap. Table 7-1 also shows that for both modeling approaches, the infiltration through the proposed RCRA cap is lower than that predicted for the EPA guidance cap. This indicates that the performance of the proposed cap exceeds that of the EPA guidance cap.

A detailed description of the UNSAT-H and HELP model analyses and results are also presented in Appendix H.

7.1.3 Frost Penetration

The low conductivity layer (the FML/GCL in the proposed RCRA cap) should be protected against frost penetration by a soil cover. The thickness of the cover should be more than the maximum depth of frost penetration for the site area. The maximum observed depth of frost penetration for the Pocatello site area is reported to be 3.2 feet (University of Idaho, 1992). The data base from the University of Idaho contains records from 1978 through 1987 and needs updating. However, according to the University records, deeper frost has not occurred since 1987. The University data base accumulates data for the soils at Aberdeen, ID, which are generally sandy to gravel in nature. The FMC Pocatello Engineering Design Data (FMC, ES 1988) indicate the frost depth to be at 3 feet below the ground surface. Therefore, the GCL will be covered by over 3.5 feet of soil as defined in Section 7.2.6.

7.1.4 Gas Generation

EPA guidance indicates that gases may be emitted from an impoundment by one of four gas generation mechanisms: biological activity of impounded solids, venting of entrained gases, vaporization of liquids, and chemical reactions (EPA 1982). The potential for gas generation by these mechanisms from the Phase IV ponds is discussed below.

The Phase IV ponds solids consist of fine-grained furnace solids (ore, coke and silica) and elemental phosphorus from the precipitators, and residual sludge and dirt contained in phossy water after processing at the phosphorus loading dock. The pond solids are rock or mineral particles and do not contain organic matter; therefore, the solids will not decompose biologically to create gases or voids.

There are no gases entrained in the small particles (sediments) slurried to the ponds. There may be phosphine gas dissolved in the water used to slurry the sediments. Following the initial fill and dewatering of the pond, the pond solids will not be subject to agitation (wind created wave action) that promotes exsolution of phosphine (see discussion of phosphine generation below) from pond water. Therefore, venting of entrained gases is not expected to be significant.

Recent temperature monitoring at Pond 8S indicated that the temperature at the pond solids/fill interface was below 20°C. The temperature range at Pond 8S in a closed condition is far below the melting point and vapor point of the inorganic constituents contained in the pond solids. The Phase IV ponds will be capped similar to Pond 8S; therefore, gas generation by volatilization will not occur.

The most important chemical reaction of elemental phosphorus is oxidation (Van Wazer 1973). When exposed to air, elemental phosphorus oxidizes to produce phosphorus pentoxide, P_4O_{10} (commonly expressed as P_2O_5), which exists as a particulate at ambient temperatures. Phosphorus pentoxide has a strong affinity for water and will react immediately with water, including moisture in the atmosphere, to form various phosphorus acids. Phosphine gas, PH_3, may be produced as an intermediate hydrolysis product but will readily undergo oxidation to P_2O_5 and H_2O (Lai and Rosenblatt 1977; Spanggord et al. 1985). While minor amounts of intermediate oxidation and hydrolysis products may be present, the predominant product of elemental phosphorus oxidation and hydrolysis will be orthophosphoric acid, H_3PO_4.

Oxidation of elemental phosphorus present in phossy pond solids is essentially eliminated by maintaining a water blanket over the ponds at all times. Even following the initial fill, dewatering and eventual final capping of the Phase IV ponds, the pond solids will remain saturated (only free water is removed during closure) and the sand/slag fill will prevent exposure of the solids to air. Therefore, oxidation of elemental phosphorus to phosphorus pentoxide (and potential formation of phosphine gas as an intermediate hydrolysis product) is not a significant reaction in the buried solids.

Phosphorus under water or soil can oxidize to produce various solid compounds, depending upon the amount of oxygen available (Lai and Rosenblatt 1977; Spanggord et al. 1985). In the subsurface, the rate of the oxidation reaction is limited based on the amount of dissolved oxygen in the water. Oxygen may also be available by diffusion in the soil. However, because the pond solids are and will remain nearly saturated, diffusion is probably not a significant mechanism. The wick drains installed in the Phase IV ponds will not act as oxygen conduits because: 1) the wicks do not extend above the initial sand fill layer (the tops of the wicks are to be buried under several feet of slag fill), 2) the wicks will collapse in an accordion fashion under the weight of the sediments during primary consolidation, and 3) the wicks will remain nearly saturated.

With the exception of Pond 16S, observation of conditions at all other ponds that have been backfilled provide supporting evidence that there is no indication of significant (observable) phosphine buildup under the temporary cover. Phosphine buildup was detected at the western anchor trench of the Pond 16S temporary cover in early spring 2001. This buildup is potentially attributable to the phosphine released during sludge intrusive activities of the center dike construction which was trapped by the immediate construction of the initial fill and temporary cover. The procurement and the installation of a Calgon's Centaur™ carbon adsorption system, as described in Section 7.1.4.2, was immediately initiated and the installation completed within a three-week period. This system has successfully treated off-gas from Pond 16S.

Unlike Pond 16S, the Phase IV ponds did not require a center dike for initial sand fill placement. The initial fill sand over the Phase IV ponds was placed using conveyor type equipment working from the perimeter dikes of the ponds. Therefore, there were no pond solid intrusive activities during the placement of the initial fill. There is no observable gas generation occurring underneath the temporary liner after initial fill and temporary cover installation.

There is no evidence of detectable exothermic chemical reactions at the Phase IV ponds. Groundwater temperature in groundwater monitoring wells downgradient of the Phase IV ponds is not elevated compared to the temperature in the upgradient monitoring well. During the 2000 groundwater monitoring, the temperature of groundwater from up-gradient Well 167 was measured at a range from 13.9 to 14.4 degrees Celsius (C) compared to 13.4 to 13.9, 10.6 to 10.9, 13.0 to 13.5, and 11.7 to 13.3 degrees C for the downgradient wells 104, 114, 131 and 168, respectively (see Table 5-1).

Based on the characteristics of the waste and the chemical behavior of phosphorus in an oxygen-limited environment, there is a low potential for reaction of phosphorus in the pond sediments. Observations at Pond 8S support the predicted low reaction potential of phosphorus in pond sediments that have been capped. There is no evidence of gas generation or exothermal reactions occurring in the pond solids. Slow oxidation of elemental phosphorus may occur in the pond solids, but the reaction is predominantly a transformation to solid-phase metal-phosphates that are not mobile in the subsurface.

As discussed above, oxidation of the waste in the Phase IV ponds is unlikely because the waste is saturated. Furthermore, the pond wastes will be capped with an engineered RCRA cap which practically eliminates the potential for evaporative moisture losses and limits the oxygen available for oxidation of elemental phosphorus in the waste.

In the unlikely event that there is air migration through soils that allows oxygen to reach the surface of the waste, a reaction may occur. The amount of oxygen available for oxidation of the waste material will be limited as the air can only reach the waste by entering through soils and/or pond backfill. If any gases are produced from such a reaction at the surface of the waste, they will move through the sand and slag backfill covering the waste either upwards or laterally towards the sides of the ponds. The Phase IV ponds are lined with a flexible membrane liner. Any gas generated inside the pond will not migrate laterally through the existing pond liner system, but will be trapped underneath the final cap. Therefore, no gas monitoring system is proposed outside the cap limits.

However, if gas generation continues and as the pressure builds up, gases migrating upwards will be trapped underneath the membrane and start migrating laterally beneath the final cover. These gases will be monitored and collected, if required, by the pressure monitoring/collection system that is to be installed within the sand layer underneath the geosynthetic clay liner (GCL) of the final cover.

7.1.4.1 Temperature and Pressure Monitoring

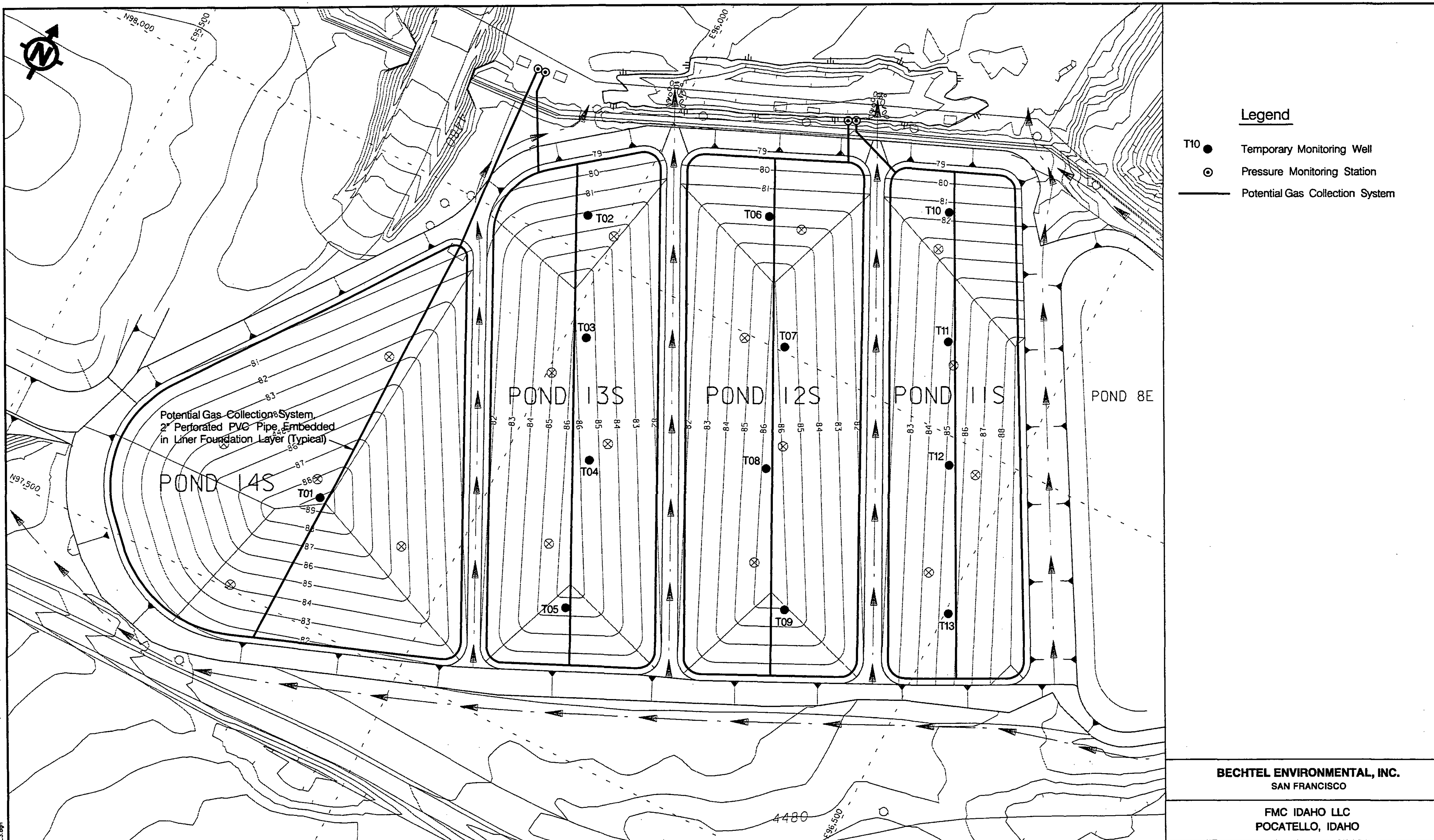
Temperature Monitoring.

To ensure that the cap functions with minimum maintenance, a monitoring system designed to monitor temperature will be installed in the sand layer above the waste and underneath the slag initial fill. The system is designed to provide early warning of a rise in temperature in the waste which may be indicative of a reaction. The operations and maintenance of the monitoring systems are discussed in Attachment 10-1, Section 2.6.2 and Attachment 10-2b, Section 4. The temperature monitoring system will consist of 13 probes installed in the ponds as shown on Figure 7-3 and Drawings 270-C-213 and 214, Appendix I. The spacing between probes will be about 200 feet. Four probes each will be installed in Ponds 11S, 12S and 13S. Only one probe will be installed in Pond 14S as the thickness of the pond solids is relatively thin (approximately 1 foot) and was displaced to the center of the pond by placement of the initial fill. Vertically, the probes will extend to the center of the sand backfill layer, approximately 3 feet above the top of the waste. The sludge and initial fill interface vary in elevation throughout each pond. The sludge has settled and will continue to settle under the recently placed initial fill load. The proposed 3-foot depth limit provides a reasonable margin of safety to preclude penetration of the sludge by the temperature monitoring wells and thus avoids potential introduction of air into sludge through the probe "wells".

Temperature will be continuously recorded by installing resistance temperature detector (RTD) sensors inside each monitoring well. Data will be collected and reviewed quarterly. Temperature transmitters will be installed on top of the well risers. The signals from the transmitters will be routed to the Local Monitoring Panel (see Drawings 270-C-214, 270-E-210 to 213, Appendix I). If the temperature inside the well reaches 22 degrees Celsius, an alarm will sound on the Local Monitoring Panel, and an externally visible light will go on to designate the problem well. The location of the Local Monitoring Panel is shown on Drawing 270-C-214, Appendix I. The temperature threshold of 22 degrees Celsius (°C) was set on the basis that 16°C is background ground water temperature with a 6°C (approximately 10°F) allowance for variability for shallow soils that may be influenced by external temperature fluctuations.

If the temperature exceeds 22 degrees Celsius at any time between quarterly data collection events, a round of sampling and data collection will be conducted at all temperature monitoring wells to assess whether there is a gas production problem. For this purpose, the temperature monitoring well riser is equipped with a sampling outlet fitted with a full port ball valve, a 2-foot long 1/4-inch polypropylene tubing, and a compression nut with ferrule at the free end (see Detail 1 on Drawing 270-C-220, Appendix I).

The gas samples will be collected using portable battery operated gas detectors for monitoring phosphine/hydrogen emissions. The details of the gas detector are presented in Figure 7-4. Hydrogen monitoring will be conducted first because hydrogen is lighter and is expected to be present at the top of the casing. The soil gas monitor with the hydrogen detector will be connected to the fitting. The hydrogen monitoring valve will be opened and the monitor will be energized to start the pump. Monitoring will continue until the displayed concentration does not



Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC IDAHO LLC
POCATELLO, IDAHO

Phase IV Ponds
Pressure and Temperature Monitoring System

Job Number	Drawing No.	Rev.
24230	Figure 7-3	1

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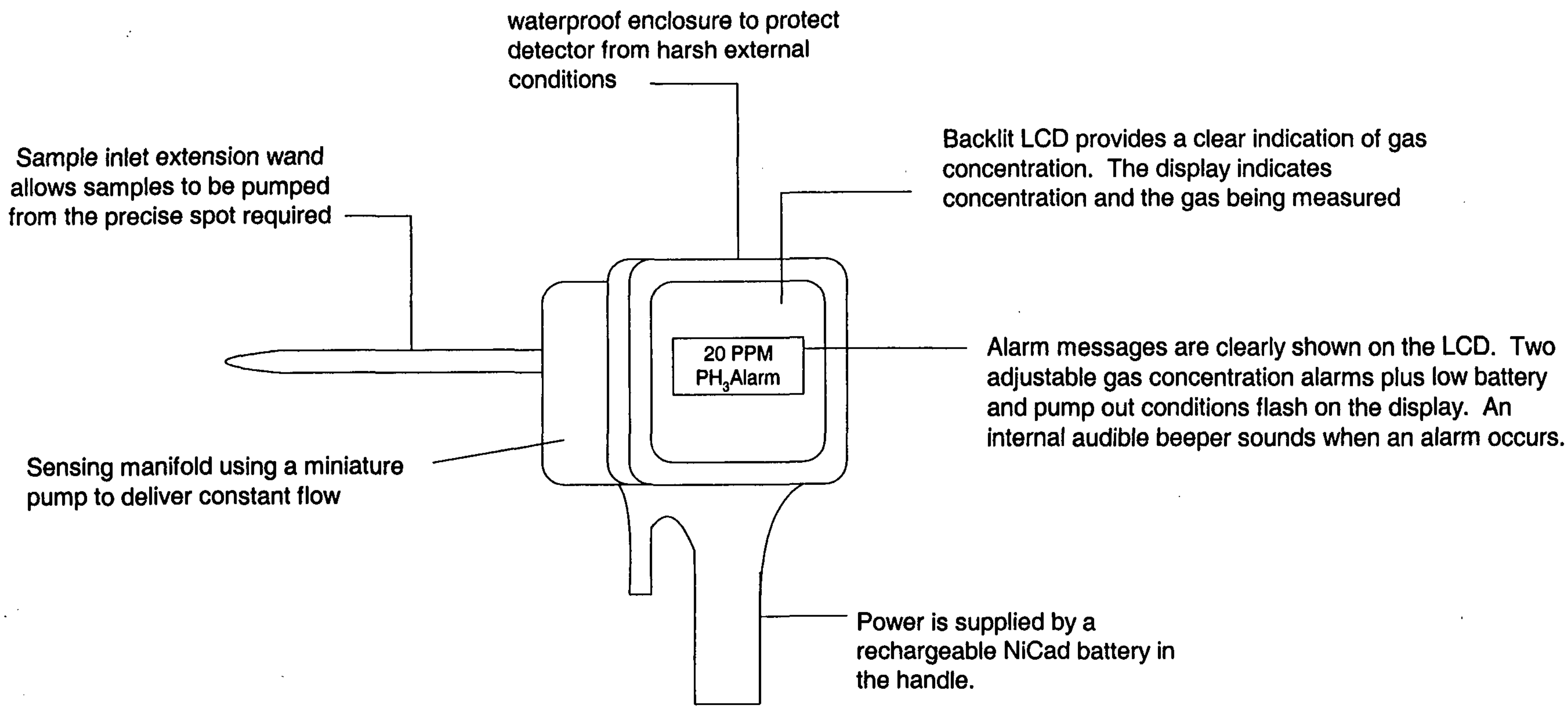
Phase IV Ponds Closure Plan



NOTE:
One detector is dedicated to each gas.

HYDROGEN/PHOSPHINE GAS DETECTOR

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO, LLC POCATELLO, IDAHO			
Hydrogen/Phospine Gas Detector Details			
BECHTEL	Job No.	Drawing No.	Rev.
	24230	Figure 7-4	1

change appreciably with time. The maximum measured concentration and the final measured concentration will be recorded in the field logbook. The monitoring valve will be closed and the soil gas monitor disconnected from the fitting.

Phosphine monitoring will be conducted after hydrogen monitoring. The soil gas monitor with the phosphine detector will be connected to the fitting. The monitoring valve will be opened and the monitor will be energized to start the pump. Monitoring will continue until the displayed concentration does not change appreciably with time. The maximum measured concentration and the final measured concentration will be recorded in the field logbook. The monitoring valve will be closed and the soil gas monitor disconnected from the fitting.

If phosphine is detected, the soil gas monitor will be turned off, the monitoring valve will be closed, the soil gas monitor will be disconnected from the fitting. The soil gas monitor with the hydrogen cyanide detector will then be connected to the fitting. The monitoring valve will be opened and the monitor will be energized to start the pump. Monitoring will continue until the displayed concentration does not change appreciably with time. The maximum measured concentration and the final measured concentration will be recorded in the field logbook. The monitoring valve will be closed and the soil gas monitor disconnected from the fitting.

Pressure Monitoring (Gas Collection) System.

The pressure monitoring system for each of the ponds, which, if necessary, can be converted to a gas collection system, consists of a 2-inch perforated PVC peripheral gas collection pipe and a pipe along the longest dimension and through the center of each of the ponds (NW to SE). The system will be installed in the 6-inch liner foundation (sand) layer directly underneath the GCL of the final cap. The systems are shown on Drawings 270-C-213 and 214, Appendix I. The operations and maintenance of the monitoring systems are discussed in Attachment 10-1, Section 2.6.2 and Attachment 10-2b, Section 4.

The estimated rate of phosphine production is based on FT-IR monitoring data from Pond 16S prior to closure activities. The average estimated production rate from Pond 16S using measured data was 0.599 g/s for the period January-March 1999, and 0.508 g/s for the period October-November 1999 (Bechtel, 2000). Using the higher of these two production rates, and prorating the phosphine production based on the ratio of the volume of waste between the Phase IV ponds and Pond 16S, the estimated production rate for Ponds 11S, 12S, 13S and 14S is about 12, 12, 5, and 1 kg/day, or about 7.9, 7.9, 3.6 and 0.6 m^3/day respectively (the density of PH_3 at one atmosphere is approximately 1.5 Kg/m^3). These estimates are very conservative because they are based on phosphine production rate data prior to closure, and can be viewed as an upper bound estimate for the rate of potential phosphine production.

Assuming the concentration of the phosphine in the gas to be collected underneath the final cap to be at a level of about 1%, the maximum gas collected through the systems for the Phase IV ponds, which are those for Ponds 11S and 12S, would be 790 m^3/day (20 cfm). Under this assumption and using a 2-inch pipe, the maximum velocity in the pipes would be about 15 ft/s. These are maximum estimates, and it is anticipated that most of the time the flow rate and velocity through the gas collection system will be much lower.

If required, the pressure monitoring system will be converted to a gas collection system to prevent pressure buildup underneath the GCL. Any gases collected will be analyzed for phosphine and hydrogen gases and, if needed, will be treated prior to their release to the atmosphere.

The pressure monitoring system as described above will be equipped with an absolute pressure sensor. The pressure monitoring instrumentation and installation details are shown on Drawing 270-C-220, Detail 2, Appendix I. The absolute pressure at the 6-inch sand layer placed directly underneath the GCL will be sensed by a pressure sensor connected to an extension of the collection pipe located in the sand layer underneath the GCL.

The signals from the pressure sensor, as well as the temperature sensors, will be transmitted by their respective 2-wire transmitters located on top of the cover to a NEMA 4X box, the Local Monitoring Panel (that houses the power supply, alarm, recorders and digital indicators). The location of the Local Monitoring Panel is shown on Drawing 270-C-214, Appendix I. The real time measurements will be displayed by digital type indicators (Drawing 270-E-211, Appendix I).

Recorders will be inkless digital type capable of recording at least 6500 instrument readings with associated times. A hand-held terminal will be provided to download each transmitter record for data logging into the computer in accordance with the software historical trending and data analysis. Data will be collected and reviewed quarterly. If the pressure reaches 27 inches of mercury, an alarm will sound on the alarm box and the pressure alarm light goes on. The maximum recorded sea level corrected atmospheric pressure in the Pocatello region is 31.13 inches of mercury (January 1979). This pressure, adjusted for the Phase IV Ponds elevation of 4500 feet, corresponds to 26.27 inches of mercury. The trigger level of 27 inches of mercury is set at slightly above this maximum recorded pressure.

Upon confirmation that the gas pressure exceeds 27 inches of mercury, soil gas sampling will be conducted. If gas samples from the pressure monitoring system indicate detectable concentrations of phosphine or hydrogen gas and the pressure remains above 27 inches of mercury continuously for a one-week period, FMC will procure and install the treatment system and convert the pressure monitoring system to a gas collection and treatment system in accordance with Section 7.1.4.2.

7.1.4.2 Treatment of Phosphine Gas

If substantial amounts of phosphine gas are generated, offgases will be collected and treated using one of the following technologies:

- Thermal oxidation.
- Catalytic adsorptive carbon (Calgon's Centaur™ technology).

Thermal oxidation is carried out at approximately 1,400°F. The treatment system will be composed of thermal oxidation and liquid scrubbing units. The thermal oxidizer will convert phosphine to phosphorus oxide, which in turn will be scrubbed by water. Phosphorus oxide will dissolve in water to form phosphoric acid. An alternative to wet scrubbing is spray drying, followed by particulate collection in which phosphorus oxide is collected in solid form. Any carbon monoxide and hydrogen that may be present in the offgas will be oxidized to non-harmful products (carbon dioxide and water).

Calgon Carbon's Centaur™ technology (patent pending) can also be used to remove phosphine from the pond offgases. Centaur™ catalytic adsorptive carbon converts the phosphine to non-toxic, strongly adsorbed phosphorus compounds. Centaur™ is a vapor phase virgin activated carbon that has been manufactured to develop catalytic functionality. Similar to the thermal oxidation method, carbon monoxide and hydrogen that may be present in the offgas will be oxidized to carbon dioxide and water in this process.

The Centaur™ technology is similar to a conventional granular activated carbon (GAC) adsorption technology. The only difference is the type of carbon used. The Centaur™ carbon structure has more catalytic sites for electron transfer than the standard GAC structure and promotes a wider range of chemical reactions than a conventional carbon. It utilizes both adsorption and catalysis.

The Centaur™ carbon effectively adsorbs gases such as phosphine, hydrogen cyanide, and hydrogen sulfide. Chemical oxidation reactions occur on the catalytic surfaces when sufficient oxygen is present in the offgas stream. Some supplemental air (if required) could be injected into the inlet of the Centaur™ unit. Spent carbon can be regenerated using water, which dissolves phosphorus oxides forming phosphoric acid.

Centaur™ carbon is manufactured to a Peroxide Number specification. The Peroxide Number measures the rate of decomposition of hydrogen peroxide by the carbon and is an indicator of the amount of catalytic activity. The lower the number, the more active the product is in terms of its ability to accelerate a chemical reaction. Specific tests exist to measure activated carbon's Peroxide Number.

Centaur™ has the following benefits when it is compared with the catalytic and thermal oxidation systems:

- Offers an alternative to expensive catalysts or scrubber/incinerator systems.
- Suitable for a wide range of catalytic applications.
- Works well at low reactant (phosphine) concentrations.
- Provides faster reaction rates requiring smaller adsorption equipment and less carbon usage.
- One or two 55-gal drums filled with carbon may be sufficient for this project.
- Eliminates ignition and exothermic concerns with metal and alkali-impregnated carbons.
- Can be regenerated on-site or recycled through off-site thermal reactivation.
- Easy to procure and install.
- Calgon Carbon promises to deliver it in less than 10 days.
- Since the lead time is short, there is no need to purchase any treatment system until seeing phosphine generated in the pond.
- Unlike the thermal oxidizers, there is no heating up or other lag period prior gas treatment.
- Operation and maintenance is much simpler and easier than for a thermal unit.

Based on the evaluation of the treatment technologies, the Calgon's Centaur™ system appears to be most appropriate for the treatment of offgas that may potentially be generated from the

Phase IV ponds. Table 7-2 presents the schedule for the design and the implementation of this treatment process.

TABLE 7-2
GAS TREATMENT SCHEDULE

Activities	Days after monitoring systems indicate gas treatment requirement[1]
Gas treatment system design	0 -14
Procuring the system	14 - 30
System delivery	30 - 50
Installation	50 - 60

[1] Schedule does not include any permitting if required.

A thermal treatment system's lead time will be several months longer when compared with this technology.

7.2 PROPOSED RCRA CAP DESIGN

On the basis of the design requirements presented in the previous sections, the proposed RCRA cap design was developed, as illustrated in Figure 7-2. The cap consists, from bottom to top, of a layer of GCL barrier underlying a flexible membrane liner and a geonet (GN) drainage layer. The geonet is protected from soil intrusion from above by a geotextile. A soil/slag cover is placed over the cap for protection against the elements, erosion, and animal or human intrusion. The design features of the initial backfill, subgrade, and the various components of the proposed cap are described in the following paragraphs.

7.2.1 Initial Fill

The initial fill and placement of a temporary cover was completed on Pond 11S on October 21, 1999, on Pond 12S on October 24, 1999, on Pond 13S on October 19, 1999, and on Pond 14S on September 30, 1999. Different filling sequences were used for the Phase IV ponds, since the thickness of the sediments in each pond varies. Specifically, a survey conducted prior to the 1999 construction work at each pond indicated that Ponds 11S and 12S contained sediments of approximately 16 feet, while Pond 13S contained about 10 feet of sediments. The average sediment thickness in Pond 13S was later determined during construction to be only about 4 to 5 feet thick. The thickness of sediments in Pond 14S was found to be slightly over 2 feet.

Initial filling at Ponds 11S, 12S and 13S began with the placement of a single piece of geofabric filter over the pond solids, followed by the placement of sand using conveyor-type placement equipment to backfill each pond in layers of controlled thickness. This method was developed from experience gained from the successful backfilling of Pond 8S in 1994 (FMC 1998b). The initial fill material consisted of local borrowed sand and slag material. Slag will also be used as the protective cover layer and is described in more detail in Section 7.2.6. The slag is not a RCRA hazardous waste, as indicated by the TCLP test data shown in Table 7-3. Additional slag analytical data is presented in Table 7-4.

The maximum depths of the backfill were approximately 12, 16, and 22 feet for Ponds 11S, 12S, and 13S, respectively, and varied throughout the ponds depending on the graded initial fill surface and the pond sludge compression during placement. The initial filling procedure is described in more detail in Section 8.6.2, and the initial fill plans (as constructed) are shown in Figures 7-5 through 7-12.

Pond 14S was backfilled with coarse, graded slag by initially end-dumping with hauling equipment to construct a ramp and platform inside the pond and then around the perimeters of the pond. Bulldozers were then used to push the slag and displace the sludge toward the middle of the pond until the open middle area was reduced to about 100 feet in diameter which allowed coverage with geofabric and filling with conveyor-type placement equipment to completely fill and cover the pond sludge. After the displacement operations using the coarse slag were completed, initial filling was commenced in a similar fashion as for Ponds 11S, 12S and 13S, with placement of a geofabric filter over the exposed middle portion of the pond, followed by placing sand using conveyor-type placement equipment to backfill the remaining portion of the pond in layers of controlled thickness, after the installation of a perforated drain. In contrast to the other Phase IV ponds which used only a single piece of Nicolon/Mirafi GC1000 geofabric as the filter, Pond 14S used three layers of a weaker available onsite geofabric (Amoco 2002) for the filter.

Once the slag levels reached the final grade at each pond, a 6-inch layer of sand was placed over the slag surface as a bedding layer on which a 40-mil temporary FML cover was placed.

Water was removed from the ponds immediately prior to and during the initial filling operations. The ponds were initially dewatered using portable suction pumps with hoses to remove free surface water. After free surface water was removed, the perforated drain pipes installed on top

TABLE 7-3
SLAG ANALYTICAL DATA - TCLP
(ALL UNITS IN mg/L)
FMC, POCATELLO, IDAHO

SOURCE	Slag Pile	Slag Pile	Slag Pile	Slag Pile	Slag Pile	Slag Pile	
FMC#	WS-SSA-01	WS-SSA-02	WS-SSA-03	WS-SSA-04	WS-SSA-05	WS-SSA-06	**TOXICITY**
LAB#	31559	31560	31561	31562	31563	31564	**CHARACTERISTIC**
DATE SAMPLED	9/1/92	9/1/92	9/1/92	9/1/92	9/1/92	9/1/92	**REGULATORY**
ANALYTICAL METHOD	TCLP	TCLP	TCLP	TCLP	TCLP	TCLP	**LIMIT**
Arsenic	0.002U	0.0015U	0.0015U	0.0015U	0.003U	0.0034U	5.0
Barium	0.9	0.685	0.65	0.67	0.84	0.6	100.0
Cadmium	0.002U	0.0045U	0.004U	0.0075U	0.0075U	0.0085U	1.0
Chromium	0.03U	0.0275U	0.0375U	0.02U	0.0275U	0.03U	5.0
Lead	0.0045U	0.0095U	0.0075U	0.017U	0.0085U	0.0055U	5.0
Mercury	0.0042	0.0003	0.002J	0.00027	0.00029	0.00186	0.2
Selenium	0.004U	0.0004U	0.003U	0.00685U	0.0048U	0.0025U	1.0
Silver	0.0008UJ	0.0008UJ	0.0008UJ	0.0015	0.0008UJ	0.001	5.0

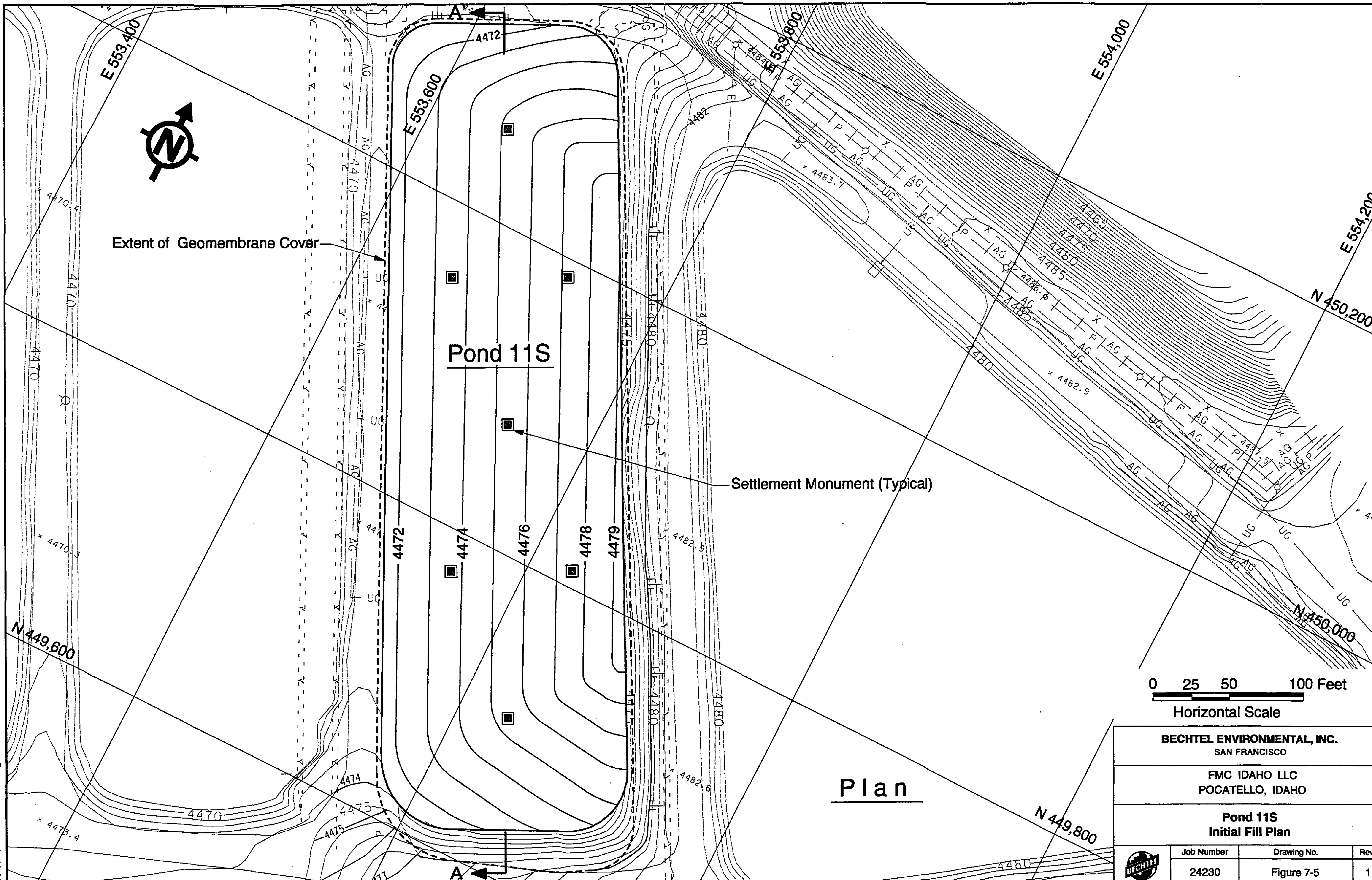
U – Not detected
J – Estimated value

TABLE 7-4
SLAG ANALYTICAL DATA
(All concentrations in mg/kg)
FMC, POCATELLO, IDAHO

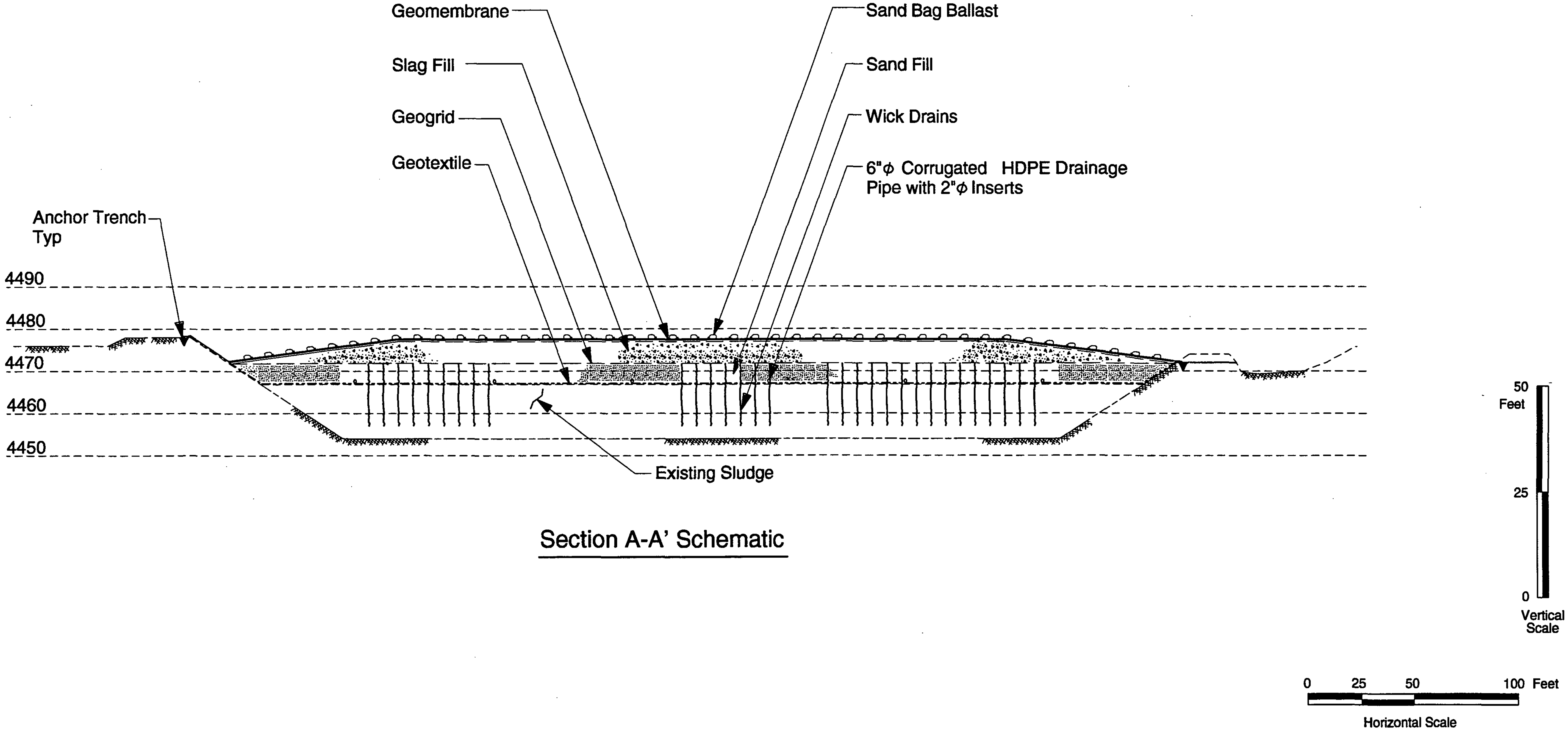
PARAMETER	FWSSSA01		FWSSSA02		FWSSSA03		FWSSSA04		FWSSSA05		FWSSSA06	
Aluminum	23600		25800		26900		24400		25700		24500	
Antimony	14.9	UJ	14.5	UJ	14.2	UJ	14.6	UJ	14.1	UJ	14	UJ
Arsenic	0.51	UJ	0.48	UJ	0.52	UJ	0.5	UJ	0.48	UJ	0.58	UJ
Barium	223		229		254		214		251		233	
Beryllium	1.9		2.1		2		1.8		1.9		1.9	
Boron	97.8		67.5		88.9		68.6		88		83.9	
Cadmium	2.8	UJ	1.2	UJ	13	J	32.4	J	10.3	J	4.3	UJ
Calcium	274000		283000		291000		255000		286000		290000	
Chromium	238		230		290		172		280		273	
Cobalt	1.2	U	1.6	U	1.6	U	1.6	U	1.4		1.6	
Copper	15.8		10.9		17.9		11.9		17.7		17	
Fluoride	14400		17800		17300		12400		16500		16200	
Iron	1150	J	772	J	1160	J	1970	J	1530	J	1410	J
Lead	6	U	5.8	U	5.7	U	5.9	U	5.7	U	5.6	U
Lithium	16.5	UJ	17.2	UJ	19.5	UJ	17.9	UJ	18.9	UJ	18	UJ
Magnesium	3200		3200		3580		5510		3610		3690	
Manganese	114		127		169		205		168		126	
Mercury	0.17	UJ	0.05	UJ	0.12	UJ	0.05	UJ	0.05	UJ	0.39	UJ
Molybdenum	2.5	U	2.5	U	2.4	U	2.5	U	2.4	U	2.4	U
Nickel	8.8		3.8	U	8.8		6.5		11.9		7.9	
Orthophosphate	46.1		44.6		91.1		57.2		30.3		104	
Total Phosphorus	1900		1610		4580		3800		3930		5680	J
Potassium	6780		7130		8160		7700		8220		7360	
Selenium	4.5	J	4.6	J	2.8	UJ	4.3	J	6.9	J	4.9	J
Silver	2.6		2.3		4.8		4.9		3.7		4.3	
Sodium	4200		4110		3970		3730		4210		4180	
Sulfate	NA		NA		NA		NA		NA		NA	
Thallium	23.2	R	22.6	R	22.2	U	22.8	R	22	R	21.8	R
Vanadium	215		183		243		150		249		250	
Zinc	52.5	J	36.4	J	194	J	450	J	136	J	85.5	J

Concentrations in mg/kg
NA – Not Analyzed
U – Not Detected
J – Estimated Value
R – Rejected Value

All analyses conducted in accordance with the EMF RI/FS Sampling and Analysis Plan (Bechtel 1992c).



\\SFOSB061\PHASE4PONDS\P4FG7_5.DGN

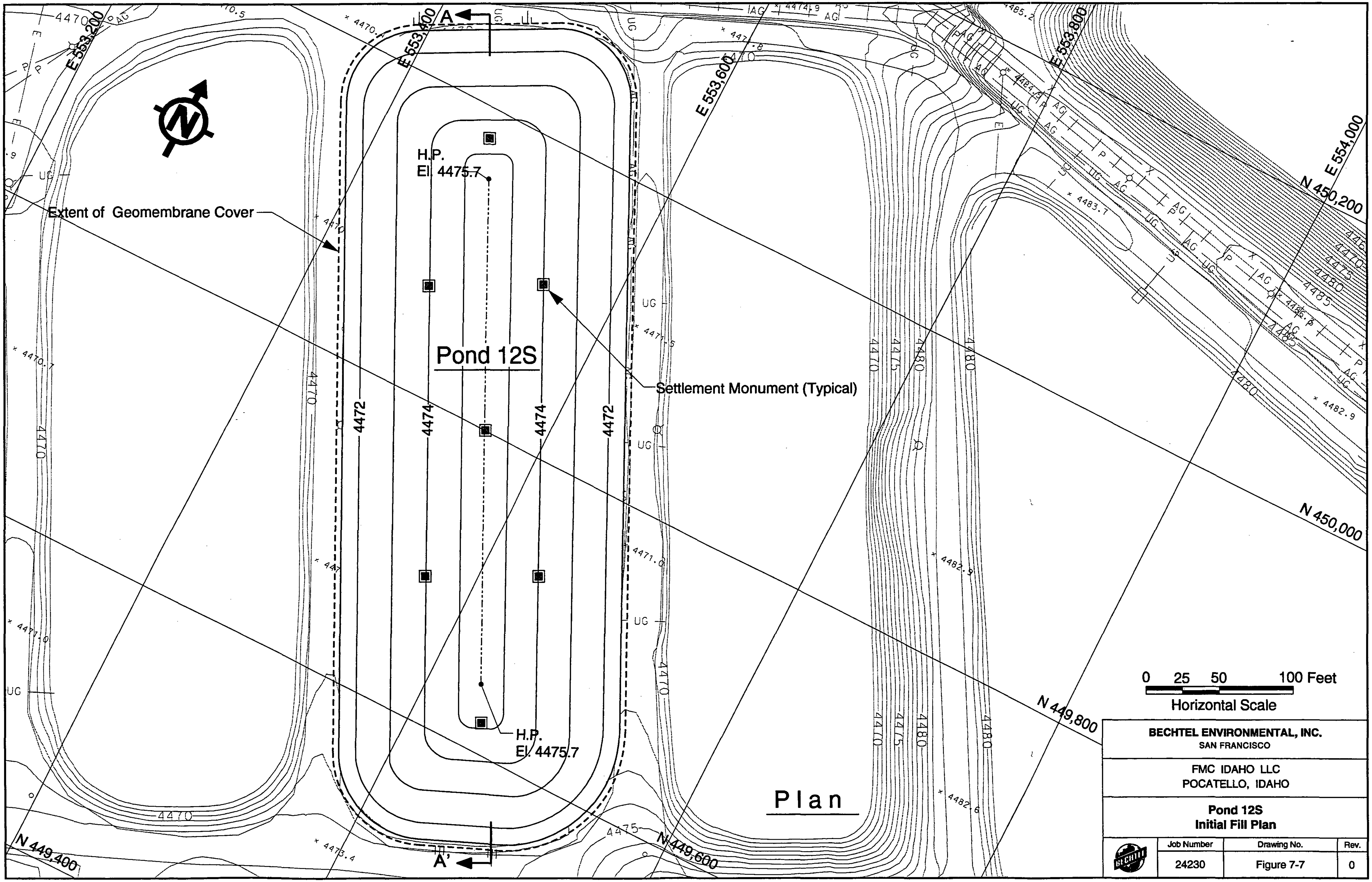


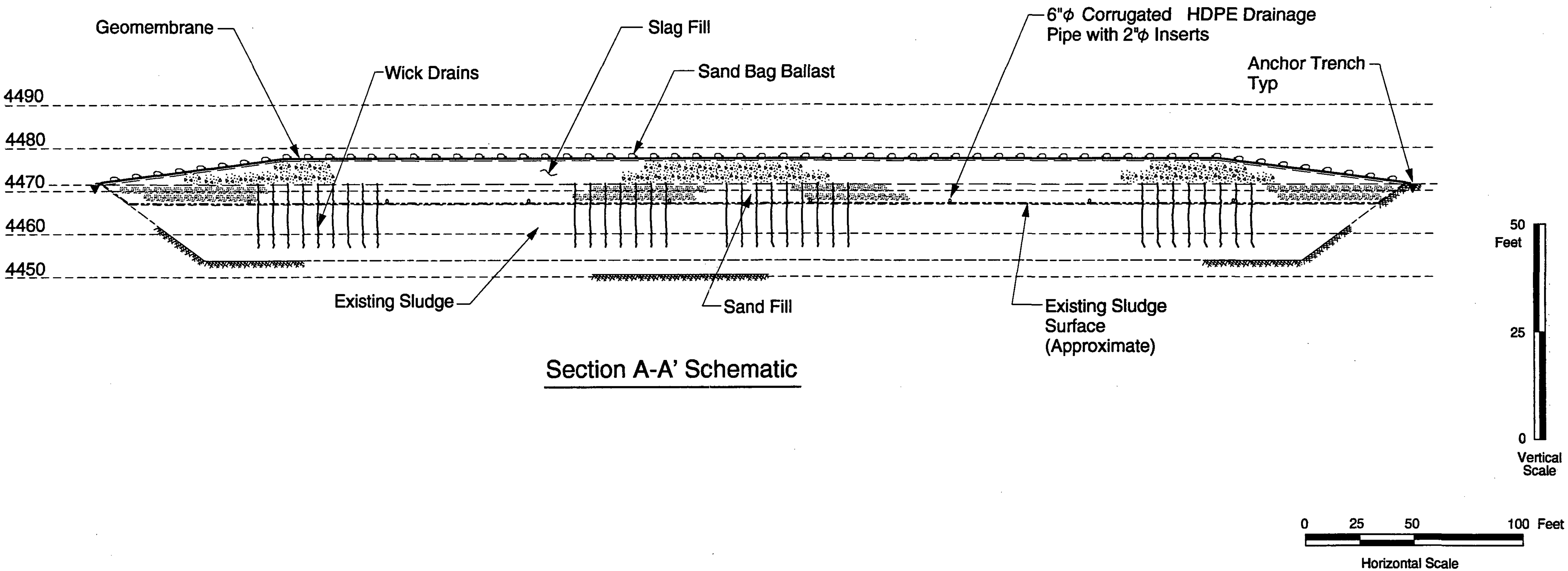
Section A-A' Schematic

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO LLC POCATELLO, IDAHO		
Pond 11S **Initial Fill Section**		
Job Number	Drawing No.	Rev.
24230	Figure 7-6	1

\\SFOSB061\PHASE4PONDS\P4FG7_6.DGN

\\SFOSB081\PHASE4PONDS\P4FG7_7.DGN





Section A-A' Schematic

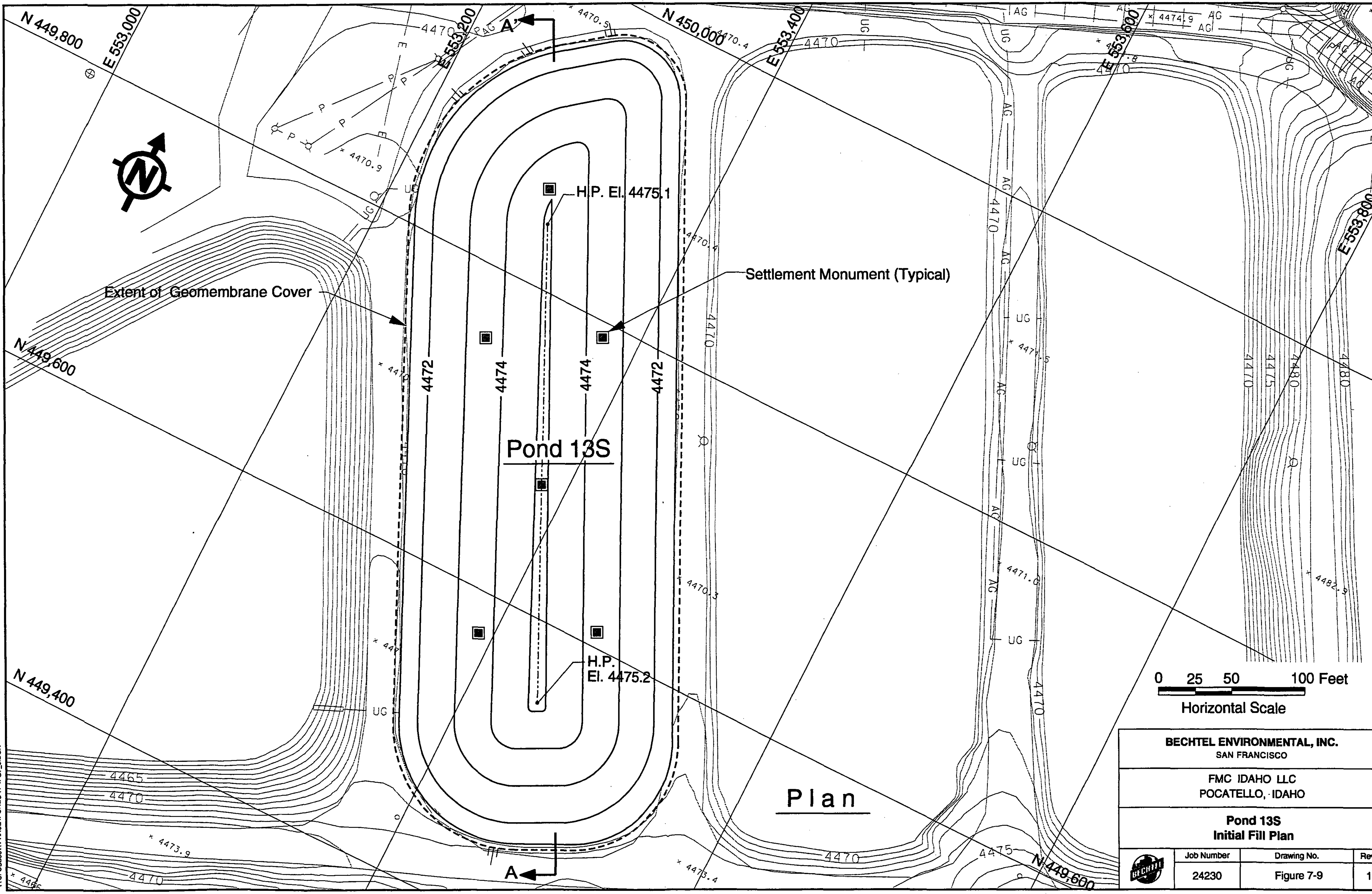
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC IDAHO LLC
POCATELLO, IDAHO

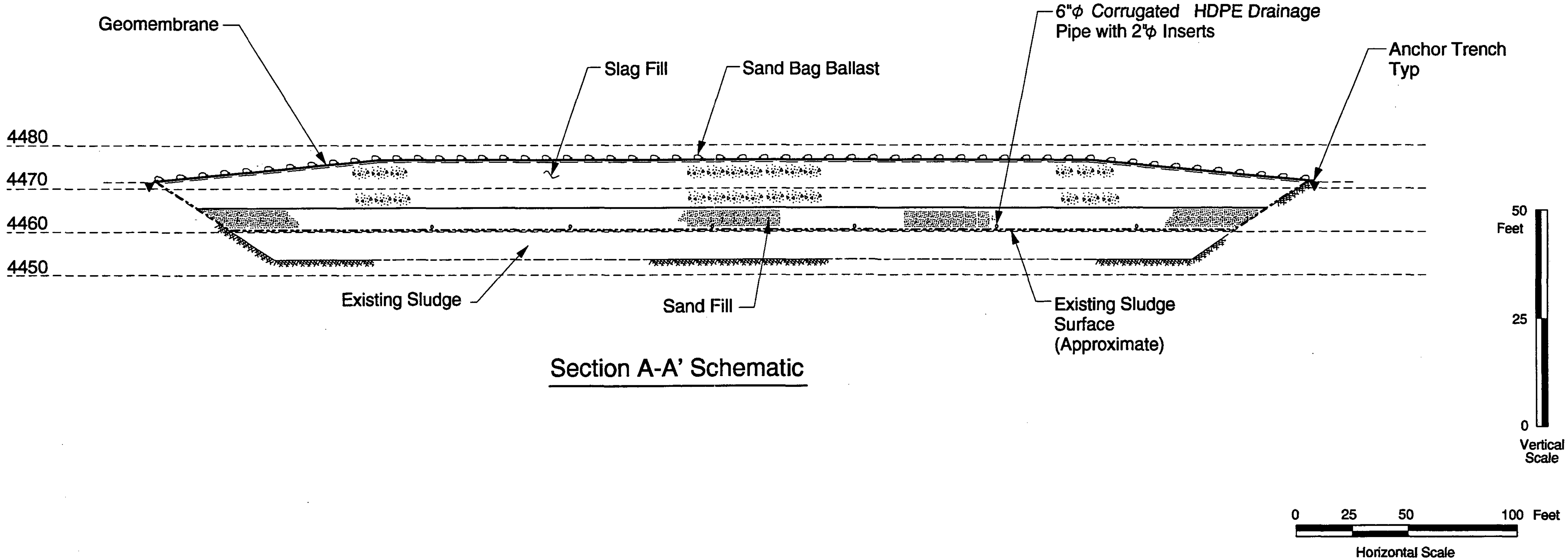
Pond 12S
Initial Fill Section

Job Number	Drawing No.	Rev.
24230	Figure 7-8	1

\\ SFOSB0611 PHASE4PONDS \ P4FG7_8.DGN



\\SFOSB061\PHASE4PONDS\P4FG7_9.DGN

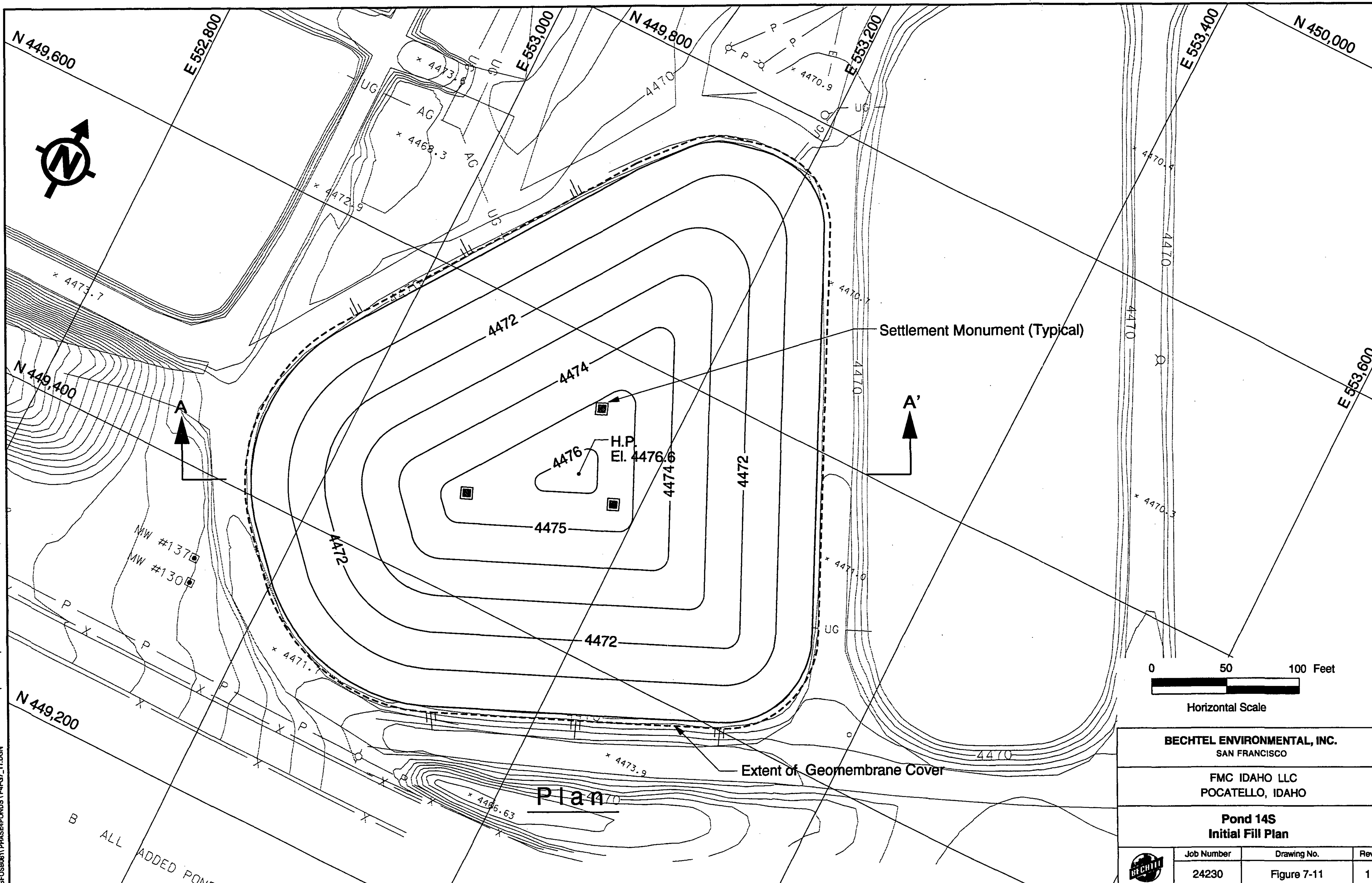


Section A-A' Schematic

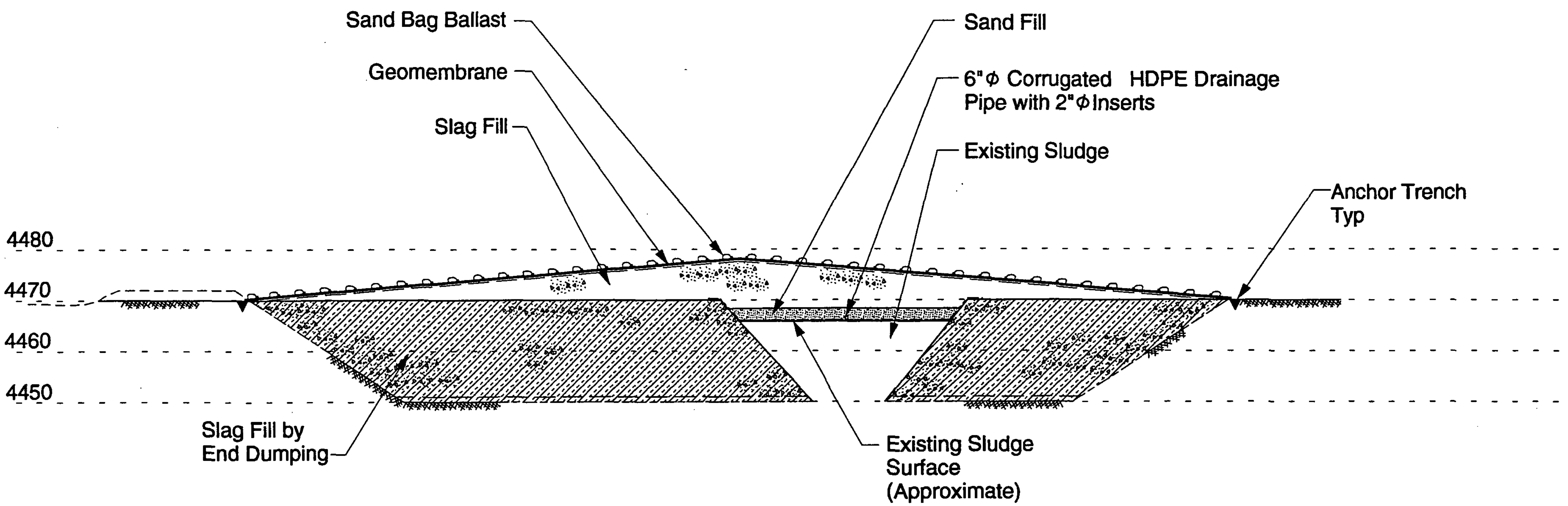
BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO LLC POCATELLO, IDAHO		
Pond 13S **Initial Fill Section**		
Job Number	Drawing No.	Rev.
24230	Figure 7-10	1

\\SFOS8061\PHASE4PONDS\P4FG7_10.DGN

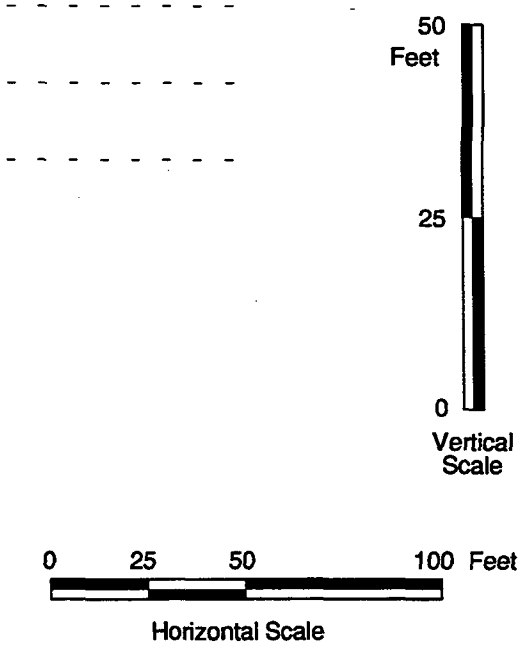
\\SFOSB061\PHASE4PONDS\P4FG7_11.DGN



Phase IV Ponds Closure Plan



Section A-A' Schematic



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO LLC POCATELLO, IDAHO		
Pond 14S Initial Fill Section		
Job Number	Drawing No.	Rev.
24230	Figure 7-12	1

\\SFOSB061\PHASE4PONDS\P4FG7_12.DGN

of the geofabric filter were used to further dewater the ponds. Pipe inserts into these perforated drain pipes were connected to the surface mounted temporary vacuum pumps, after their installation at the perimeter dike areas, to remove subsequent water accumulation to an on-site RCRA MTR surface impoundment before January 1, 2002. Any water that is removed using the dewatering system after January 1, 2002 will be pumped to a new on-site water treatment plant, or otherwise manage it in accordance with RCRA requirements.

Wick drains were installed in Ponds 11S and 12S after sufficient fill (sand) was placed over the pond sludge to support needed construction equipment. The wick drains were installed in these ponds to accelerate sludge consolidation. The wick drains penetrate the geotextile above the sludge and terminate just above the bottom of the pond solids. The wick drains consist of a geofabric filter wrapped around a permeable core. The fabric permits the flow of water while filtering out solids. The water flows, pressurized by the weight of the initial fill, into the permeable core of the wick drain, through the filter fabric above the sludge, into the sand fill, and exits through the perforated drains.

It was anticipated, due to the relatively shallow depth of sludge contained in Pond 14S, no further dewatering will be required at the pond after free surface water removal during initial filling activities. This was confirmed by a pumping test performed on the drainage pipes installed in the pond. The test indicated that the drainage pipes are dry. Therefore no dewatering pumping system was installed in Pond 14S.

Near the end of initial fill placement, the temporary dewatering systems for Ponds 11S, 12S and 13S were installed and the water was removed via the installed sets of suction pumps attached to the pipe inserts as described above. The pumps discharged the water to an onsite RCRA MTR surface impoundment. At the end of the 1999 construction season the dewatering systems for all the Phase IV ponds were disconnected and winterized to prevent damage to the pumping system due to freezing during the winter months. The system was restarted during the 2000 and 2001 seasons. Any water removed after January 1, 2002 be pumped directly to a new on-site water treatment plant or otherwise be managed in accordance with RCRA requirements.

The dewatering will continue, as needed, until the established acceptable rate of settlement, as described in Section 7.4.5, is achieved in the pond to support installation of the final cover. A schematic of the installed dewatering system is shown in Figure 7-13.

The temporary cover placed over the Phase IV ponds initial fill was designed to meet the following requirements:

- Sufficiently impermeable to prevent water infiltration into the pond fill.
- Able to withstand wind uplift.
- Able to tolerate the anticipated fill settlement.
- Have a life-span equal to or greater than the time required for the initial consolidation of the pond sludge.

Details of the temporary cover placement are also contained in Section 8.6.2.

7.2.2 Subgrade

The final cap subgrade, which will be placed over the initial fill, will consist of two 6-inch layers of well-compacted sand. The grain size distribution for both sand layers is specified in the technical specifications. Following settlement and prior to construction of the final cap, the subgrade will be regraded and compacted as required to achieve the design elevation. The sand subgrade will serve as a leveling course to provide proper bedding for the overlying geosynthetic clay liner. These design criteria will be monitored for compliance during construction. The subgrade will be well-compacted to support the construction equipment and the cap. The subgrade preparation is described in detail in Section 8.8 and in the specifications in Appendix I.

7.2.3 Geosynthetic Clay Liner (GCL)

The GCL, including the seams, will provide a hydraulic barrier equivalent to that of a 2-foot-thick layer of compacted clay having a maximum hydraulic conductivity of 1×10^{-7} cm/sec. The seams will consist of adjacent panels overlapping each other a minimum of 6 inches. The material will be a commercial synthetic fabric/Bentonite or HDPE/Bentonite composite liner, having a composite action hydraulic conductivity of less than 5×10^{-9} cm/sec. The material will be delivered to the site in rolls, and the rolls will be placed in panels on the prepared subgrade. Details are described in the specifications in Appendix I

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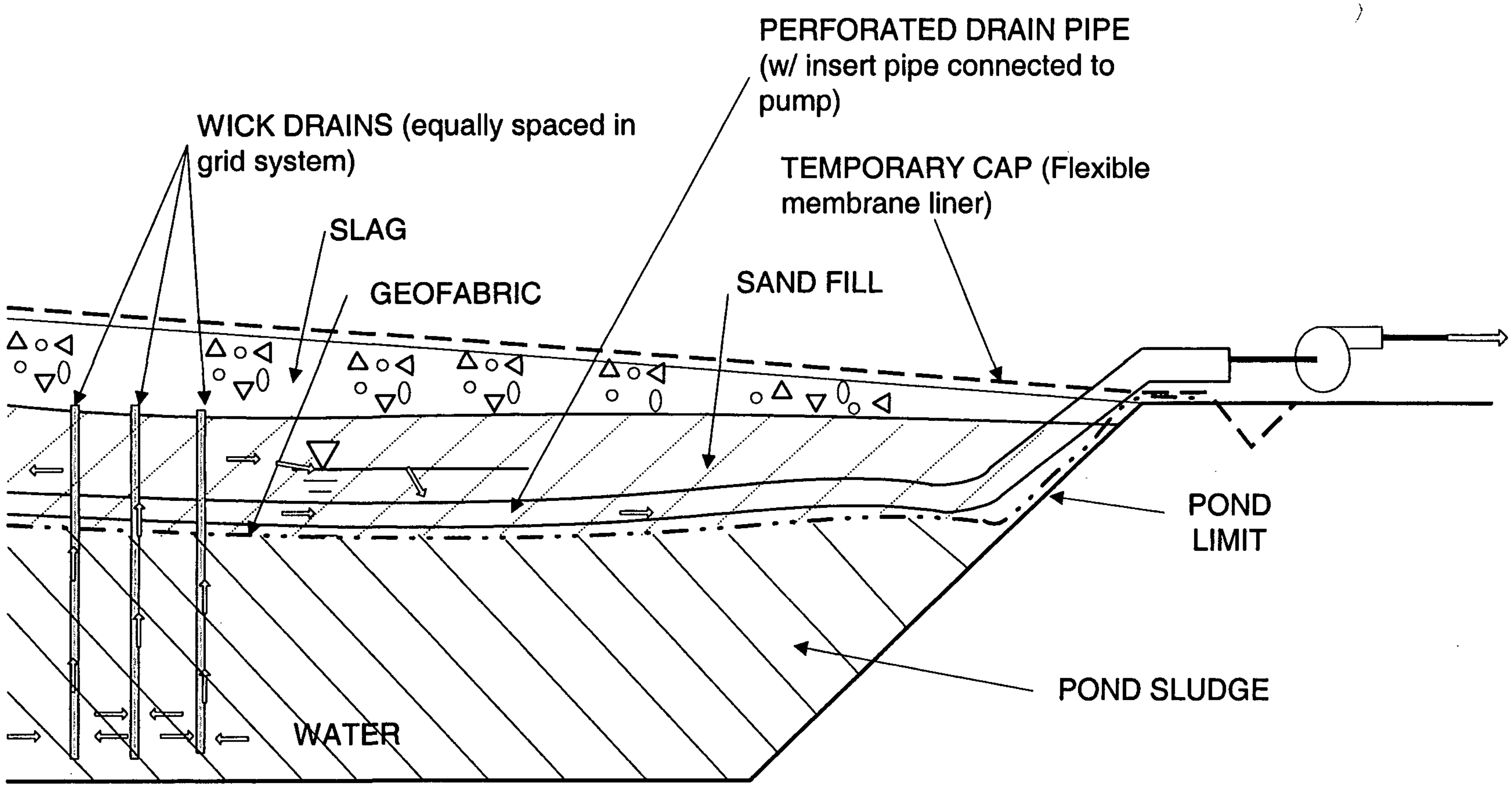


BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO, LLC POCATELLO, IDAHO			
Typical Section of the Dewatering System			
	Job No.	Drawing No.	Rev.
	24230	Figure 7-13	2

7.2.4 Flexible Membrane Liner (FML)

The FML will be HDPE having a minimum 60-mil thickness (reference Appendix I for FML design details). It will be durable to resist stresses and strains from the installation activities and to resist exposure to ultraviolet rays during placement. The overlapping areas between panels will be sealed or properly welded. The panels will be at least 22 feet wide, delivered to the job site in rolls of 300 feet or longer. The coefficient of permeability for the FML will be 2×10^{-12} cm/sec or less. The FML material used as the temporary cover will be removed and will not be reused in the final cover.

FMC contacted a major manufacturer of HDPE liners concerning the compatibility of HDPE with phosphine and elemental phosphorous. Information from this manufacturer (a copy of the correspondence is included in Appendix N) states that HDPE is compatible for use with phosphine and elemental phosphorous. In addition, an evaluation of the compatibility of geosynthetic materials common to the construction of surface impoundment leachate detection, collection, and removal systems (LDCRS) at the FMC facility, including HDPE, was performed by TRI/Environmental Inc., an independent testing laboratory in Austin, Texas. TRI/Environmental tested geosynthetic materials (including HDPE) using both a phosphorus bearing mixture of Phos Dock effluent from the north solids tank and the northeast sump and NOSAP precipitator slurry. Results indicated that the materials tested (which are representative of the Phase IV ponds cover materials) are compatible with this leachate which is, in turn, representative of the wastes managed at the Phase IV ponds (see Appendix N for a copy of the TRI/Environmental report).

HDPE liner materials also exhibit relatively low gas transmission rates. Since geomembranes are widely used for municipal landfills, methane gas transmission is of major concern in liner design. Permeability to methane gas is reported for a broad range of geomembranes. Gas transmission rates were determined by ASTM methods. Typical results of the various geomembranes tested for methane gas transmission provided by Staff Industries are included in Appendix N. The results of the tests do provide comparative performance between the various geomembranes. These results indicate that HDPE liner materials exhibit relatively low gas transmission properties similar to other geomembranes tested.

The other lower vapor transmission materials are UC 4000 (specially formulated PVC) and Hypalon. However, the advantages of HDPE material, with their higher strength and superior seaming capabilities, outweigh the slightly higher gas transmission rate. HDPE is also less subject to damage from wear and tear during construction, and unlike PVC or Hypalon, which require very special preparation for seaming, HDPE can be easily repaired should the membrane be damaged during construction or the functional life of the cap.

7.2.5 Drainage Layer

The drainage layer will consist of a layer of geosynthetic drainage net laid directly on top of the FML. This geonet (GN) layer will have a hydraulic transmissivity of greater than or equal to 2 x 10^{-5} cm^2/sec with a performance equivalent to a 1-foot-thick layer of granular soil with a hydraulic transmissivity equal to at least 3 x 10^{-2} cm/sec. A nonwoven geofabric filter will be placed over the drainage layer to prevent the overlying soil fines from migrating down into the void spaces of the GN and reducing its hydraulic transmissivity. The permittivity of the filter fabric will be 1.3 sec^{-1}, or higher. It will be of durable material, suitable for being overlain with the protective cover materials described in Subsection 7.2.6. It will also have an appropriate equivalent opening size (EOS) to prevent clogging. The details for the drainage layer slope and water removal are shown on Drawings 270-C-213, 214, 218 and 219, Appendix I.

The geonet will be installed to conform to the finished grade slopes of the final cap, and will collect and drain infiltration through the soil cover to the perimeter of the two-component, low-permeability layer. The drainage from the GN will be collected in perimeter perforated corrugated HDPE pipes which will conduct the drainage to sumps. Drainage collected in the sumps will ultimately be pumped to the final cap perimeter low-lying areas or surface drainage ditches. Each sump will be equipped with a pump, level controller, high level alarm, and totalizing flow meter.

The amount of drainage from the drainage layer of each pond will be monitored using the totalizing flow meters installed on the discharge piping connecting to the pump. The pump is to be equipped with a manual on/off switch. Prior to each annual flow volume collection, the sumps will be emptied (pumped to the preset low liquid level) by manually switching on the pumps, after which the volume of flow will be read and recorded. The readings will be evaluated with rainfall data to verify and monitor the effectiveness of the capillary barrier as described in Section 10.9. If a high level alarm is activated and there is a power or mechanical failure of the dedicated pump, a portable pump will be used to empty the sumps and the volume of flow will be measured and recorded.

7.2.6 Protective Cover

A four-layer protective soil cover will be provided to protect the hydraulic barrier from water and wind erosion, frost penetration, plant roots, burrowing animals, and human intrusion (see Detail 3, Drawing 270-C-218, Appendix I). The protective cover will have a combined minimum thickness of 7 feet, and will be placed on the geofabric that overlies the geonet. The protective cover will be comprised of sand, coarse and fine slag, and vegetative surface layers.

The sand layer that will be placed over the geosynthetic filter fabric will consist of a 12-inch-thick, sand or crushed and screened fine slag material. The sand layer will be placed using low-ground-pressure (LGP) vehicles to minimize stress on the underlying geosynthetic materials. Placement will begin around the perimeter of the pond where LGP bulldozers will push a 12-inch-thick lift of sand over the geosynthetic filter while traveling only on the newly placed sand layer. The sand layer will be covered with a 18-inch-thick lift of coarse slag as quickly as practicable behind the advancing face of the sand layer to provide further protection for the liner components against repeated dozer and truck traffic during slag placement. Prior to the placement of coarse slag, a test compaction fill section will be performed at a selected pond location. This test section will determine the compaction requirements for the full depth of the coarse slag layer. The compaction requirements for the coarse slag will be monitored and controlled using criteria established from this test fill section, as specified in detail in the technical specifications included in Appendix I.

The coarse slag fill is a crushed material with particle sizes ranging from 1-1/2 to 12 inches. Specific gradation tests on the material are not available; however, crushing and then screening to remove various finer fractions (for the production of displacement fill material used in the demonstration dike fill for Pond 15S) have produced the following data:

Size (inches)	% by Weight Smaller
4	93
2	69
1-1/2	65

Visual inspection of this material indicated few 12-inch stones, with the general maximum sizes ranging from 6 to 8 inches.

The general crushed slag product is composed of silt, sand, gravel, and cobbles to a maximum size of 12 inches. This layer will deter animals from burrowing into the cap as the slag is relatively unyielding and difficult to dig through. In the same manner, human intrusion will also be discouraged by this layer. The gradation and the slag material properties will provide a relatively difficult layer even for typical drill rigs to penetrate. In the event of unintended human intrusion beyond this layer, the underlying geosynthetics, in combination with the 5 to 10 or more feet of sand and slag fill (placed during the initial fill operation), will provide deterrence and/or additional warning prior to any human exposure to the waste. Given the additional 5 to 10 or more feet of sand and slag placed above the waste, a thicker biointrusion layer in the cap will not add any significant additional deterrence for human intrusion. Therefore, an 18-inch-thick layer of large crushed and screened slag is considered to be adequate for the biotic barrier.

To prevent migration of topsoil into the coarse slag layer, a gravel filter layer overlain by a sand filter layer will be placed above the coarse slag layer. These two transition layers will each be 6 inches in thickness and consist of gravel, sand or crushed and screened slag meeting the gradations as specified in the technical specification included in Appendix I. These gradations are established using U.S. Bureau of Reclamation filter design criteria (Earth Manual procedure EM-1110-2-1901).

The surface layer will consist of a 30-inch thick layer of topsoil overlain by a 12-inch thick layer of topsoil mixed with 15% (by weight) of pea gravel. The pea gravel is mixed into the topsoil to improve its ability to resist wind erosion if the cover is temporarily denuded of vegetation. Vegetation will be rooted into this surface layer which will sustain its development. The vegetative cover will be a mixture of native grasses. To provide vegetation compatible with the local climatic conditions, the mixture was developed through consultation with the Agricultural Research Center, College of Forestry, University of Idaho, Moscow, ID, and the Cooperative Extension System, University of Idaho, Pocatello, ID.

The protective cover thickness of 7 feet is adequate for frost protection since it is greater than the maximum depth of frost penetration (3.2 feet) reported for the Pocatello area (see Subsection 7.1.3).

7.3 CAP GRADING

The final cap (shown on Drawings 270-C-213 and 214, and Detail 1 of Drawing 270-C-218, Appendix I) will fully cover the Phase IV ponds including their dike areas. The cap will be graded with a slope of approximately 5 percent to promote effective runoff and minimize the potential for erosion. The final grades are shown in Drawings 270-C-213, 214, 216 and 217,

Appendix I.

7.4 SETTLEMENT

This section summarizes the results of calculations performed to evaluate the final cap settlement for the planned cover design configuration for the Phase IV ponds using pond-specific soil parameters developed for Ponds 11S, 12S, and 13S in the document entitled "Final Report, Geotechnical Laboratory Test Results, Ponds 8E, 11S, 12S, and 13S, FMC's Elemental Phosphorus Plant", prepared by Applied Geotechnical Engineer Consultants, Inc., October 13, 1997 (Appendix L). Since the Phase IV ponds will all be closed simultaneously, the initial analyses considered Ponds 11S and 12S (see Appendix M, Calc. No. 24230-027-1), which have the thickest amount of sludge (approximately 16 feet in each pond). An additional analysis was performed for Pond 11S after the initial fill settlement was nearing completion to account for final grading and current slag levels (see Appendix M, Calc. No. 24230-027-4). Pond 12S is about equal thickness and loading conditions as Pond 11S; therefore, an additional analysis for Pond 12S was not performed. Ponds 13S and 14S, which only contain about 5 feet and 1 foot of sludge, respectively, are expected to settle a lesser amount and more quickly than the other two ponds. This section also evaluates the performance of wick drains to accelerate the rate of settlement in Ponds 11S and 12S.

7.4.1 Geotechnical Investigation

Geotechnical analyses are required to estimate the amount and rate of settlement of the sludge in the Phase IV ponds. The settlement of the sludge is a function of the sludge compressibility and the stresses imposed by the initial and final cap loading.

The principal features of the initial fill activities included: (1) the placement of a single piece of geofabric filter over the pond, (2) the use of a conveyor-type placement equipment/system to place the initial sand fill over the sludge in thin controlled layers to attain a thickness of approximately 5 feet, and (3) placement of 4 to 23 feet of slag fill.

The weight of the fill will cause consolidation of the pond solids and time-dependent settlement of the fill layer. The magnitude and rate of settlement of the fill are important factors in the planning, design, and scheduling of the closure process.

Estimating the magnitude and rate of settlement of very soft, fine-grained sediments is based on an approximate, but well-established, process. Strength and consolidation characteristics are normally measured in the laboratory using undisturbed samples of the sediments. Using these data, the analysis normally yields reasonable results for the magnitude of settlement; however, without the support of field measurements, the prediction of time rates of settlement is an approximate calculation.

In the case of the phossy wastes, the accuracy of estimates for both the magnitude and time rate of settlement is severely degraded, because it is impossible to obtain undisturbed samples and it is difficult to measure basic, essential soil properties accurately. Due to the presence of elemental phosphorus in the pond solids, extreme effort, special equipment, and non-standard procedures are required to test the materials in the laboratory in a safe manner.

Information on the properties of the phossy sediments was first obtained from disturbed samples and in-situ vane shear tests at several locations in Ponds 8S (WMU #7) and 15S (WMU #3). The vane shear tests indicated the very soft nature of the Pond 8S sludge and the even weaker condition of sludge in Pond 15S. This information on the pond solids, together with additional published data, was used to estimate settlement at Pond 8S upon closure.

In July 1997, a field and laboratory investigation program for Phase IV ponds was conducted. The field investigation consisted of in-situ vane shear tests and sludge sampling at representative locations in the ponds. The in-situ vane shear test results indicated that the phossy waste in Ponds 11S, 12S and 13S are essentially of the same strength as those found in Pond 15S. Results of the field investigation are summarized in Appendix K. Samples of the sludge were obtained from Ponds 11S, 12S and 13S and tested in the laboratory using specialized equipment and methodologies to determine moisture content, Atterberg Limits parameters, specific gravity, grain size distribution, and consolidation parameters. The results of the pond-specific laboratory testing program are summarized in Appendix L. The settlement analysis for the Phase IV ponds included in this closure plan is based on pond-specific laboratory data, and takes into account the settlement monitoring data obtained from Pond 8S and confirmed by settlement monitoring of the initial fills placed over the Phase IV ponds. Approximate analytical methods were employed in the settlement analysis, allowing for changes in basic soil properties (void ratio, permeability, and compressibility) that were expected during consolidation of these very soft sediments/pond sludges. The settlement analysis is included in Appendix M, Calc's. 24230-027-1 and 24230-027-4 of this Closure Plan.

7.4.2 Pond Loading

The pond phase-loading conditions are summarized in Table 7-5. The loading at each pond was assumed to result from placing initial fill consisting of 5 feet of sand fill with the balance composed of slag fill. The amount of slag to be placed was increased by the amount of estimated sludge settlement and a re-estimate of settlement was performed for each pond analyzed using the new total slag thickness. The permanent phreatic surface was assumed to be maintained at the bottom of the sand fill by pumping.

For Ponds 11S, the initial fill before installing the final cap exerted pressures up to about 1,849 pounds per square foot (psf). The permanent cap will not be added until after the pond has settled sufficiently under the sand and slag loads. The final cap and regarding will add another 1,008 psf to develop a total loading of 2,857 psf for Pond 11S.

TABLE 7-5
SUMMARY OF LOADS - PHASE IV PONDS

Description	Unit	Pond 11S	Pond 12S	Pond 13S	Pond 14S	Comment
Elevation top of slag	feet	4478.6	4479.1	4479.3	4483.6	
Elevation top of sludge	feet	4467.3	4467.1	4455.3	4451.5	
Elevation pond bottom [min.]	feet	4451.5	4451.3	4451.1	4450.4	
Sludge thickness	feet	15.8	15.8	4.2	1.1	
Sand thickness	feet	5	5	5	5	
Final slag thickness	feet	9.8	12.5	18.8	33.1	
Regrading thickness	feet	1.4	0.8	0.5	-1.0	
Final cap thickness	feet	7	7	7	7	
Additional pressure – sand	psf[1]	575	575	575	575	
Additional pressure – slag	psf	1274	1625	2438	3003	
Additional pressure – cap	psf	840	840	840	840	
Additional pressure – regrading	psf	168	96	60	120	
Total Additional Pressure	psf	2857	3136	3913	4298	

Notes: Total unit weight sand 115 pcf[2]
Total unit weight slag 130 pcf
Total unit weight cap 120 pcf
The last digit of elevation/thickness values may not add up due to rounding.

[1] pcf = pounds per cubic foot
[2] psf = pounds per square foot

7.4.3 Soil Parameters

Pond-specific laboratory test data from the Phase IV ponds were used to derive soil parameters for use in the settlement analyses.

The results of the laboratory consolidation tests performed on the Phase IV pond sediments indicated a high degree of compressibility under low loads, and that a substantial portion of the total settlement will occur under a load of approximately 300 to 400 psf, which is a small fraction of the total cap loading.

The time required for the consolidation of the pond sludge at any given level of pressure is inversely proportional to the coefficient of consolidation (Cv) parameter. This parameter is proportional to the square of the length of the drainage path and inversely proportional to the time required for consolidation to occur. The expression for this parameter is:

$$Cv = T_{90} (H^2) / t_{90}$$

where H = average drainage distance of the sample for each load increment.

t_{90} = time for 90% consolidation.

T_{90} = time factor, 0.848 for 90% consolidation.

Values of t_{90} are obtained from the consolidation time curves for each load increment.

Data used to determine the coefficient of consolidation are presented in Appendix M.

7.4.4 Predicted Settlement

The settlement analyses were performed using computer codes "ACCUMV" from the University of Colorado at Boulder (ACCUMV, the One-Dimensional Consolidation of Saturated Clays, a Computer Program for Non-linear Finite Strain Theory, by Schiffman, R. L., Sravits-Nessan, V., and McArthur, J.M., December, 1992). ACCUMV is a finite difference code which implements a nonlinear finite strain theory of consolidation that accounts for changes in the thickness of the consolidating stratum (i.e. drainage path length). The program also accommodates nonlinear strain-dependent relationships of void ratio and permeability.

The main input parameters for the analyses included the following:

- Initial thickness of sludge.
- Assumes drainage occurs only in the vertically upward direction.
- Water level at top of sludge prior to loading.
- Compressibility, $e = e_i - C_c \log(\frac{\sigma'_0 + \Delta\sigma'}{\sigma'_0})$;
- where e_i = void ratio intercept at 1 psf on void ratio versus log (effective pressure) relationship
  C_c = slope of void ratio versus log(effective pressure) relationship
  e = void ratio
  σ'_0 = initial effective soil pressure
  $\Delta\sigma'$ = change in effective soil pressure

- Permeability (k) assumed to vary with void ratio, using the relationship $k = 0.005\ e^{2.6}$ (ft./month), for both Pond 11S and Pond 12S, which was derived by fitting a curve through laboratory test results.
- Coefficient of consolidation (Cv) assumed to vary with void ratio.
- Fill loading modeled as a linearly increasing load over an approximate 1-month period.

Initially, the model was checked against field measurements and previous analyses performed for the Pond 8S and Pond 15S. Results using ACCUMV produced similar settlement amounts and rates. These calculations were performed using the pond sludge thicknesses indicated in Table 7-5, which are the thicknesses of sediments in the Phase IV ponds estimated prior to the 1999 construction season.

The estimated total settlement resulting from primary consolidation of pond sediments under different stages of load are summarized in Table 7-6. Settlement will extend beyond the period of primary consolidation by continued secondary settlement, or creep, as discussed in the next section.

TABLE 7-6
SUMMARY OF LOAD/SETTLEMENT ANALYSIS RESULTS FOR POND 11S

Phase of Construction	Net Pressure (psf) [1]	Primary Settlement (feet)
Begin	0	0
Sand fill, 5-feet	575	1.2
Sand and 1 foot of slag (near perimeter dike)	705	1.3
Sand and 4 feet of slag	1849	1.9
Permanent, 7-foot cap and regrading	2857	2.2

[1] psf = pounds per square foot

7.4.5 Rate of Settlement

It was assumed that the sand and slag fill would require less than 1 month to place. Calculations indicate that primary consolidation would be completed in about 12 months after filling commences for both Pond 11S and Pond 12S. The time to complete primary consolidation after addition of the sand and slag fill have varied by a month or two, dependent on the actual loading rates and amounts for each pond, and the amounts of settlement that occur during placement.

The creep trends are based on the settlement measurements made at Pond 8S, then modified to include the effects of intensity of loading and the thickness of compressible material. The adopted rate of secondary settlement is 0.315 feet per log cycle of time for Pond 11S (Pond 12S has the same rate).

It was estimated that settlement rates would be acceptable for the installation of a permanent cover during the construction season in the second, or possibly, the third year after initial fill placement. The acceptable settlement rate that must be achieved prior to commencing final closure is 1 inch per year. This criterion is incorporated in supporting calculations for the detailed cover design.

The settlement rate criterion of 1 inch per year prior to installation of the final cap was determined by settlement analyses to establish a rate that: (1) is reasonably attainable in a 1- to 2-year period after placement of initial fill, and (2) would result in a tolerable amount of settlement of the permanent cap over its design life. The settlement analyses were based initially on soil property data obtained from the literature and empirical data, and finally on laboratory tests performed on Phase IV sludge samples. The estimates of settlement rates were initially validated by field settlement measurements for Pond 8S and have been further validated by the field measurements for the Phase IV ponds.

Determining the pond readiness for installation of the final caps was dependent on the results of the settlement monitoring program described in Sections 7.4.7 and 8.7. Recent settlement monitoring data indicates that 1 inch per year was achieved for all of the Phase IV ponds by the end of the first year (2000), as noted in "Closure Settlement Report, Pond 8E, Pond 15S, and Phase IV Ponds – Progress Report No. 10; Pond 16S – Progress Report No. 6" (FMC 2002). As the final cover for the Phase IV ponds will be integrally attached to the Pond 8E final cover, construction of the final cover over the Phase IV ponds was delayed unit an acceptable rate of settlement was achieved for Pond 8E. Projection of the secondary settlement rate into the future combined with primary cap consolidation indicates the following settlement:

Elapsed Time after Permanent Cap Installation (years)	Pond 11S Settlement of Permanent Cap (inches)
0	0
5	7.5
10	8.5
20	9.6
30	10.5
50	11
100	12
500	15

The settlement that will develop over a 500-year period after closure will be tolerable for all cap components as described in Section 7.4.8. It should be carefully noted that the calculated rates of settlement are considered to be approximate and the actual rates of settlement may vary from those indicated above.

7.4.6 Wick Drains

Wick drains were installed in Ponds 11S and 12S to accelerate settlement and permit installation of the permanent cap at an earlier date, or possibly, to accelerate consolidation and strength gain of the very soft pond solids during placement of the initial fill. Due to the relatively shallow depths of sludge in Ponds 13S (5 feet) and 14S (1 foot), wick drains would provide little benefit for these two ponds and were not installed.

Wick drains were installed in Ponds 11S and 12S at the completion of the sand portion of the initial fill and before placement of the slag fill to avoid increased difficulty in installing the wick drains through slag. As described in Section 7.2.1, the wick drains penetrate the geofabric filter above the sludge and terminated just above the bottom of the pond solids. The wick drains consist of a geofabric filter wrapped around a permeable core. The fabric permits the flow of water while filtering out solids. The weight of the initial fill produces a hydraulic gradient that causes pore water to flow to the permeable core of the wick drain, upward to the top of the filter fabric above the sludge into the sand fill, and thence into the perforated subdrains. The 6-inch perforated drains, fitted with 2-inch pipe inserts, were installed above the geofabric that separates the sludge and fill. Water removal via the pipe inserts, which act as suction lines, began after the dewatering system/pumps were installed. Dewatering will continue as needed, until acceptable settlement is achieved in the ponds for final cover installation.

The rate of settlement achievable with wick drains depends on the spacing of the drains. A center-to-center drain spacing of 7 feet was used and is expected to achieve primary consolidation within 4 to 6 months after completion of filling operations. Judging from the analysis results, the benefits of using wick drains appear to be significant. However, it should be cautioned that predicting rates of consolidation is considered only to be approximate, especially when the calculation for use of wick drains is based on assumed parameters. Even without the wick drains, the primary consolidation is calculated to end within about one year. Installation of wick drains and the associated reduction of settlement duration is additional assurance against potential delay in the installation of the final cap to the next construction season.

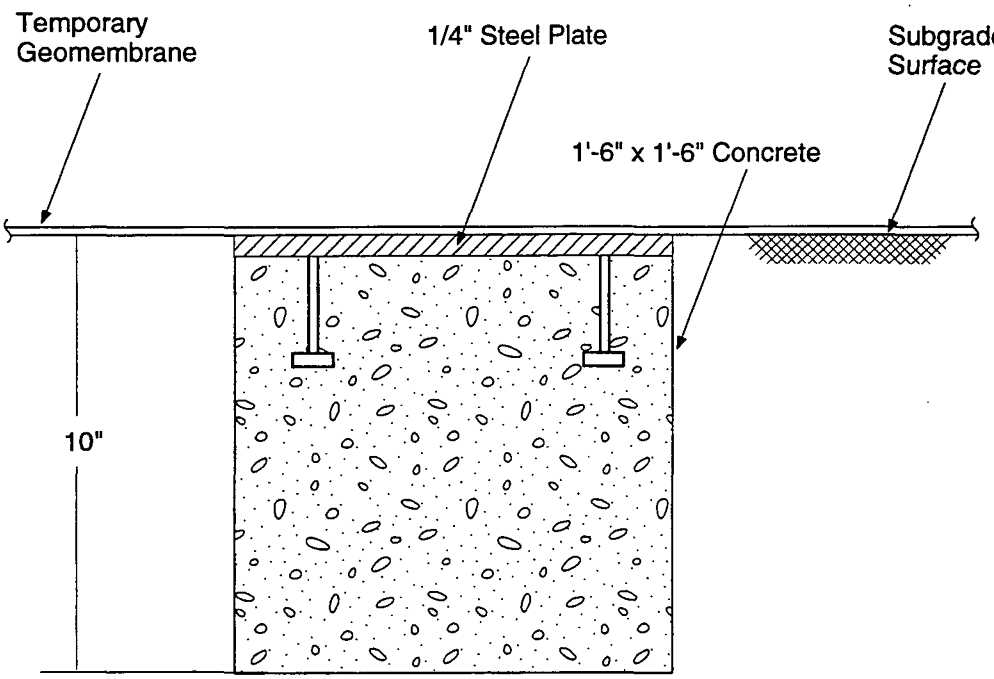
7.4.7 Settlement Monitoring

The pond solids will consolidate under the weight of the backfill, and the backfill and subgrade will therefore settle. The subgrade settlement is being monitored to verify that the settlement rate complies with criteria before the final cap is placed on the subgrade. After the initial fill was placed, an array of 23 temporary settlement monuments was installed at predetermined locations (spaced on an approximate 100-foot grid) over the Phase IV ponds in order to collect field settlement data. A schematic of a typical temporary settlement monument is shown on Figure 7-14. The field data is being used to indicate when the primary consolidation of the pond solids is essentially complete and the settlement rates are acceptable for final cap installation. The procedure for settlement monitoring is presented in Section 8.7. Initially, readings were taken at weekly, or more frequent, intervals until trends were established. Future readings will be taken at monthly intervals. Settlement data has been and will continue to be compiled and reported on a quarterly basis.

7.4.8 Projected Settlement and Final Cap Design Considerations

After settlement of the initial fill decreases to an acceptable rate, regrading will be required to provide a smooth and uniform slope for the final cap.

The final cap construction will add up to 7 feet of additional fill. Based on the long-term settlement trend data obtained from the temporary settlement monitoring at Pond 8S which were modified to reflect the loading and sludge thickness at Pond 11S, total settlement caused by construction of the final cap is estimated to be on the order of 13 inches in 500 years. Similarly, total overall settlement for Pond 12S is also estimated to be on the order of 13 inches in 500 years. The settlement under the final cap loading is expected to be relatively uniform.



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Typical Temporary Settlement Monument		
Job Number	Drawing No.	Rev.
24230	Figure 7-14	1

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04/29/02da

The maximum differentials are expected to occur along the perimeter of the ponds, where the thickness of the compressible pond bottom solids varies from zero at the side of the ponds to a maximum sludge thickness over a horizontal distance of about 3 times the sludge thickness toward the pond interior. Settlement of this magnitude is expected to reduce the 5 percent slope on the surface of the cap, resulting in a maximum uniform compressive strain (0.08 percent) in the cap. This is not expected to affect the elements of the liner. It is also possible that differential settlement may result in a depression in the plane surface of the cap that could stress the cap elements. Conservatively assuming a differential settlement area of about 100 feet in diameter and 13 inches in depth, the maximum elongation strain near the perimeter of the depression may be on the order of 5.8 percent. The assumed depression would not result in ponding on the 5-percent surface slope. The elongation properties of the HDPE membrane and the GCL are listed as follows:

Property	HDPE/Bentonite Composite liner (15mil HDPE)	Geotextile/ Bentonite Composite Liner	60 mil HDPE
Elongation at yield (%)	10	NA	12
Elongation at break (%)	500	100	500

The properties readily demonstrate that both GCL and HDPE membrane can tolerate the strains imposed by potential differential settlement of the permanent cap, as they are well below the respective yield strains. Other elements of the cap will be even more tolerant of settlement-induced strains. Therefore, settlement of the final cap is not expected to have any significant detrimental effect on the cap system.

7.4.9 Final Cap Construction

A temporary synthetic membrane will be installed over the initial fill subgrade to prevent infiltration. After it is established that the subgrade settlement has diminished to acceptable levels, the temporary cover will be removed and the slag redistributed from areas of low settlement to areas of high settlement. The final grade will be established such that the cap may be placed and the cap grading may be achieved in accordance with the final design.

Post-closure settlement of the final cap will be monitored using permanent settlement monuments (See Detail 1, Drawing 270-C-219, Appendix I). Thirteen monuments will be installed on the subgrade at the proposed locations indicated on Drawings 270-C-213 and 214, Appendix I. The frequency of settlement readings and cap maintenance due to additional settlement is addressed in Section 10.

7.5 SLOPE STABILITY

The elevations of the ground surrounding the Phase IV ponds is near the top of the dikes. Therefore, there are no concerns about the stability of exterior dike slopes. Ponds 11S, 12S and 13S contain substantial depths of sludge that buttress the 3:1 interior slopes. However, to further demonstrate the stability of dike slopes, analyses have been performed on assumed dike geometries and conditions that are more severe than those that exist in the ponds. Site-specific soils data were used. Adequate factors of safety against sliding of the dikes were determined under both static and seismic conditions for both the short-term and long-term conditions. These factors and a summary of the analyses are discussed briefly below.

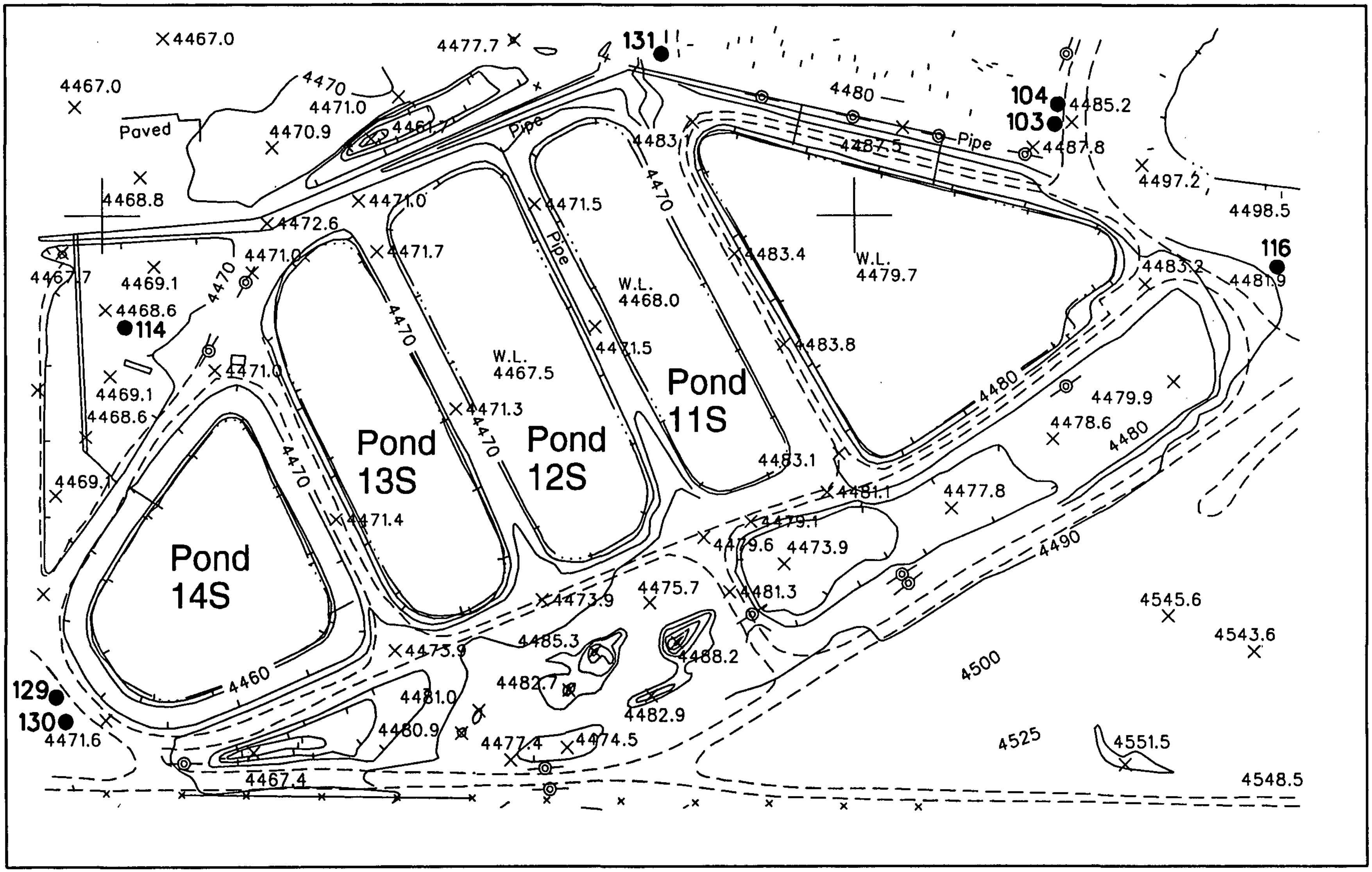
7.5.1 Soil Properties and Design Criteria

Soil conditions of the dikes, and the foundation materials on which they rest, are presented in 6 boring logs (see Figure 7-15 for boring locations) and summarized in Figure 7-16. The foundation material is a silt with an SPT N-value that increases with depth (from 18 blows per foot at shallow depth to refusal at a 50-foot depth). Based on these data, it can be inferred that the silt is dense to very dense. The body of the dike is assumed to consist of a medium dense silt fill, which corresponds to the minimum N-value of 13 blows per foot obtained from near-surface tests in borings adjacent to the Phase IV ponds.

For the after-cap completion (long-term) stability analyses, the conservative geotechnical soil parameters presented in Table 7-7 were used. The properties for the slag were conservatively assumed based on engineering judgment.

The water table beneath the Phase IV ponds, as measured in five groundwater monitoring wells in the vicinity, is at approximately 4,398 feet elevation (FMC 1996a), more than 70 feet below the tops of the dikes, well below any critical failure planes with respect to slope stability. The effects of groundwater were therefore excluded from the analyses.

Based on the UBC code (*UBC Code,* 1988, Section 2312, Figure 2 and Table 23-I), the site is in seismic zone 2B with a seismic zone factor of 0.2g. This value of acceleration was conservatively used as a pseudo-static coefficient to evaluate slope stability under seismic loading. In addition, the critical pseudo-static seismic coefficient required to create a factor of safety of 1.0 (i.e., the yield acceleration) was also determined. The effect of a crane operating along the top of the dike was also evaluated. The crane is not expected to be present after the fill is completed, but was included in the analysis for completeness.



LEGEND

103 ● Boring Designation and Location

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Location of Borings		
Job Number	Drawing No.	Rev.
24230	FIGURE 7-15	1

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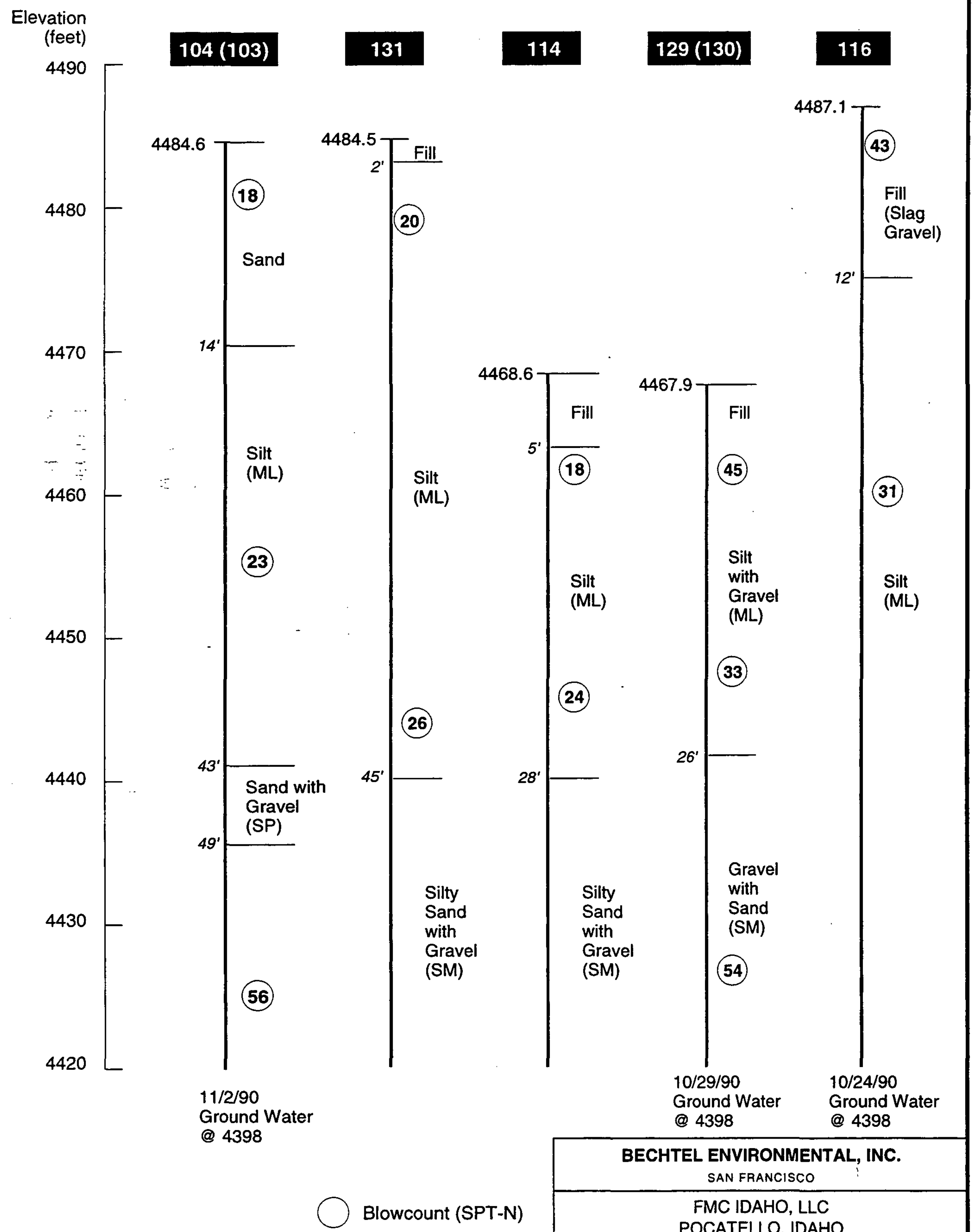
Phase IV Ponds Closure Plan



BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC IDAHO, LLC
POCATELLO, IDAHO

Summary of Boring Logs

Job Number	Drawing No.	Rev.
24230	Figure 7-16	1

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TABLE 7-7

SUMMARY OF GENERALIZED SOIL PROPERTIES AND DESIGN INFORMATION

Soil Type	Total Density (pcf)	Cohesion (psf)	Internal Friction Angle (degrees)
Cap (Slag + Sand)	120	--	35
Slag	130	--	35
Sand	115	--	30
Pond Solids	100	50	--
Dike	115	--	28
Foundation	120	--	30

pcf = pounds per cubic foot

psf = pounds per square foot

7.5.2 Methodology and Results

The slope stability analyses were performed using the computer program SLOPE/W (SLOPE/W, Version 4.20, Geo-Slope International Ltd., Calgary, Alberta, 1998), which performs analyses for circular failure surfaces. Each program run was made using an automatic search for the minimum failure surface on specified depth tangents. Based on specific dimensions and weights of the crane used for construction at Pond 8S in 1994, the crane was modeled as a 500-psf uniform load acting over a 20-foot width along the top of the dike. The sections analyzed are shown on Figures 7-17a through 7-17e.

Table 7-8 provides a summary of the minimum factors of safety from the stability analyses results for the dike sections investigated (deep-seated failure surfaces).

The results of the stability analyses indicate that the dike slopes are stable for both static and seismic conditions. Also, because the yield acceleration is greater than the adopted design acceleration (0.2g), no significant permanent deformation will result from seismic events.

Phase IV Ponds Closure Plan

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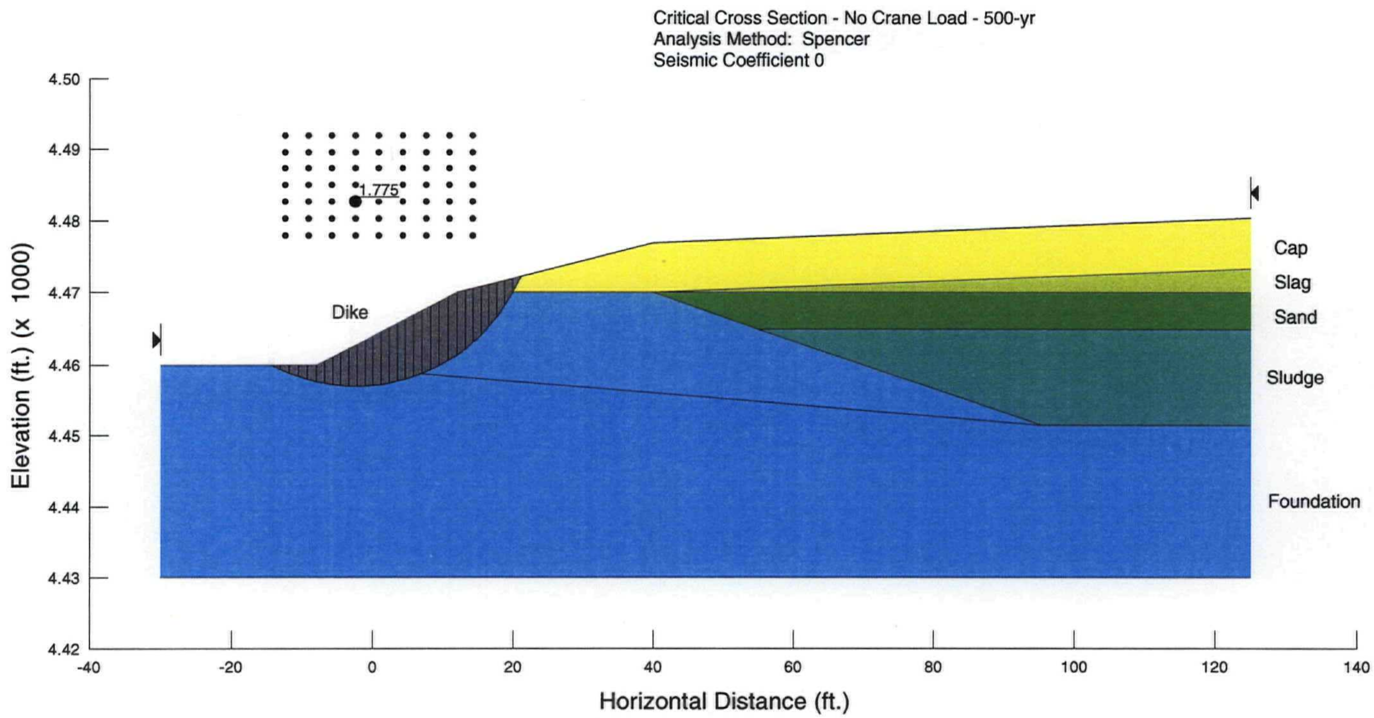

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Dike Section - Sheet 1		
Job Number	Drawing No.	Rev.
24230	Figure 7-17a	1

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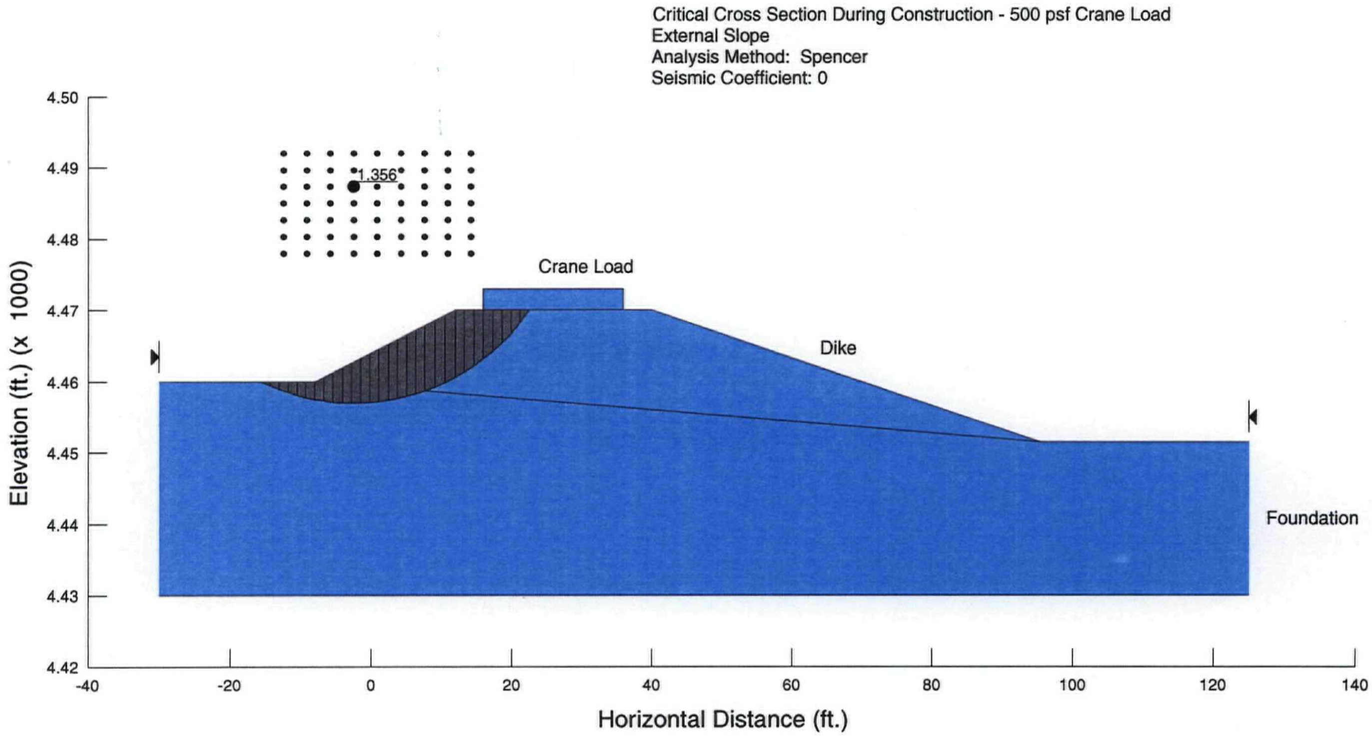
Phase IV Ponds Closure Plan



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Dike Section - Sheet 2		
Job Number	Drawing No.	Rev.
24230	Figure 7-17b	1

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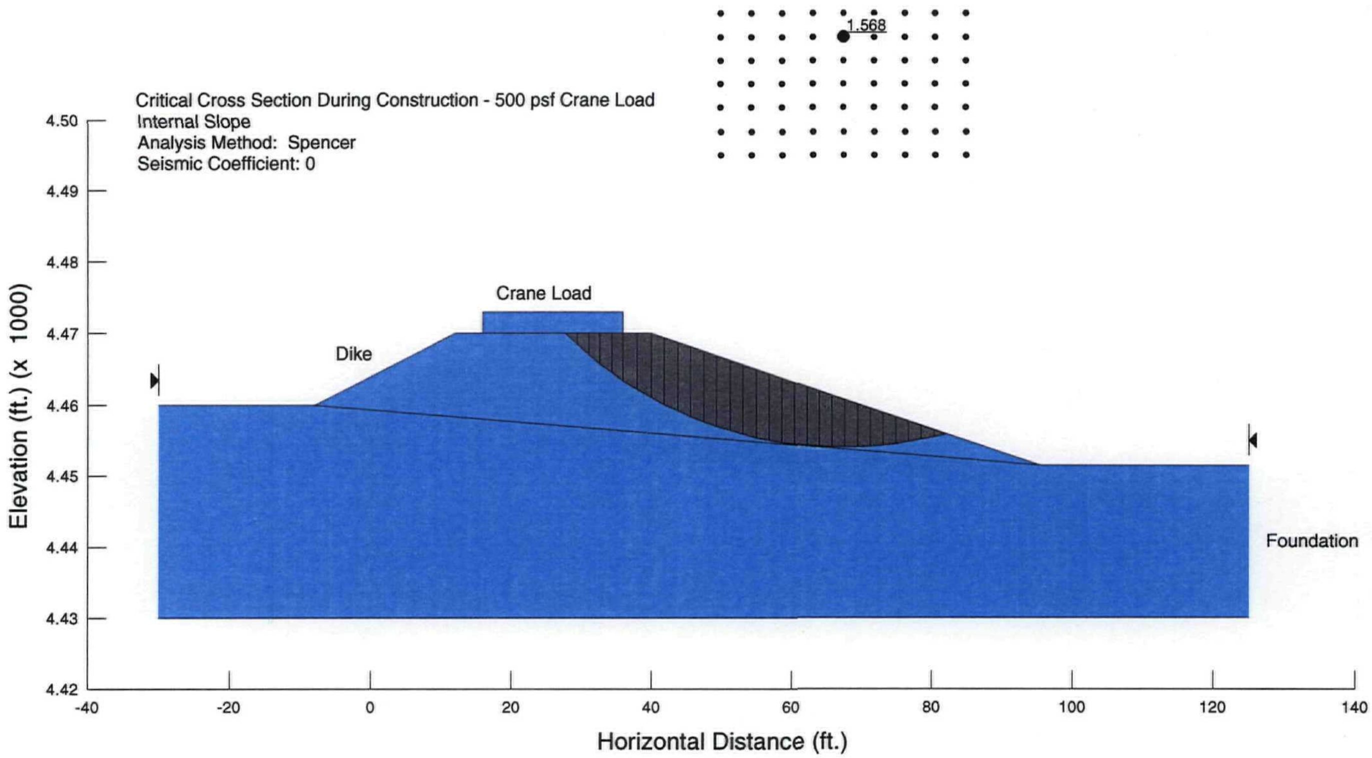
Phase IV Ponds Closure Plan



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO, LLC POCATELLO, IDAHO			
Dike Section - Sheet 3			
	Job Number	Drawing No.	Rev.
	24230	Figure 7-17c	1

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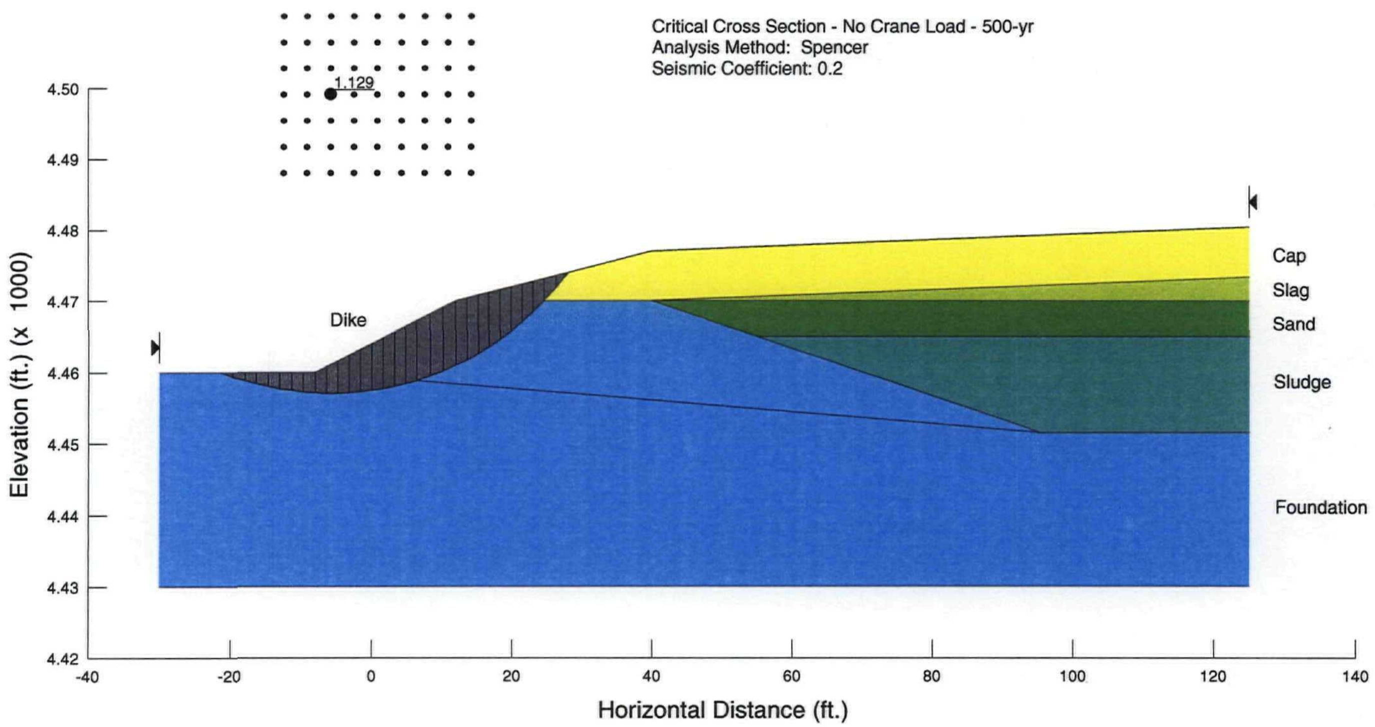

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO, LLC POCATELLO, IDAHO			
Dike Section - Sheet 4			
	Job Number	Drawing No.	Rev.
	24230	Figure 7-17d	1

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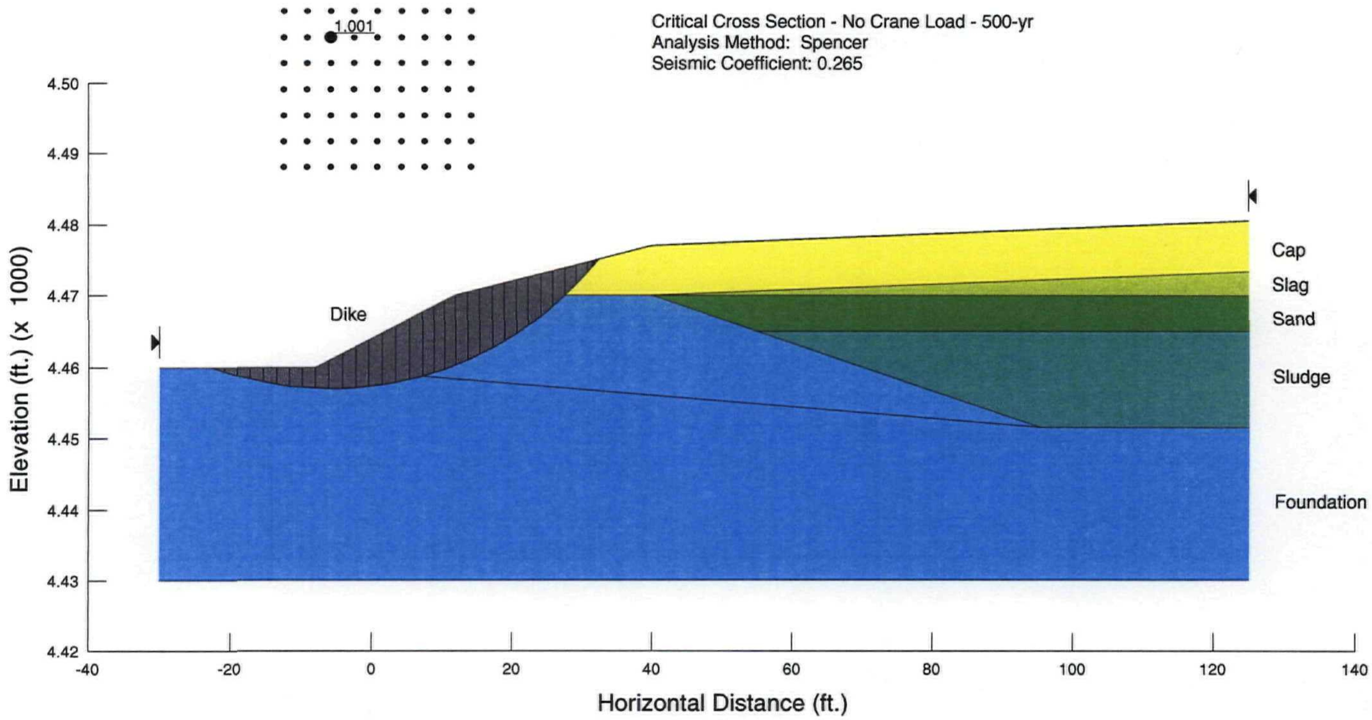
Phase IV Ponds Closure Plan



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO, LLC POCATELLO, IDAHO			
Dike Section - Sheet 5			
	Job Number	Drawing No.	Rev.
BECHTEL	24230	Figure 7-17e	1

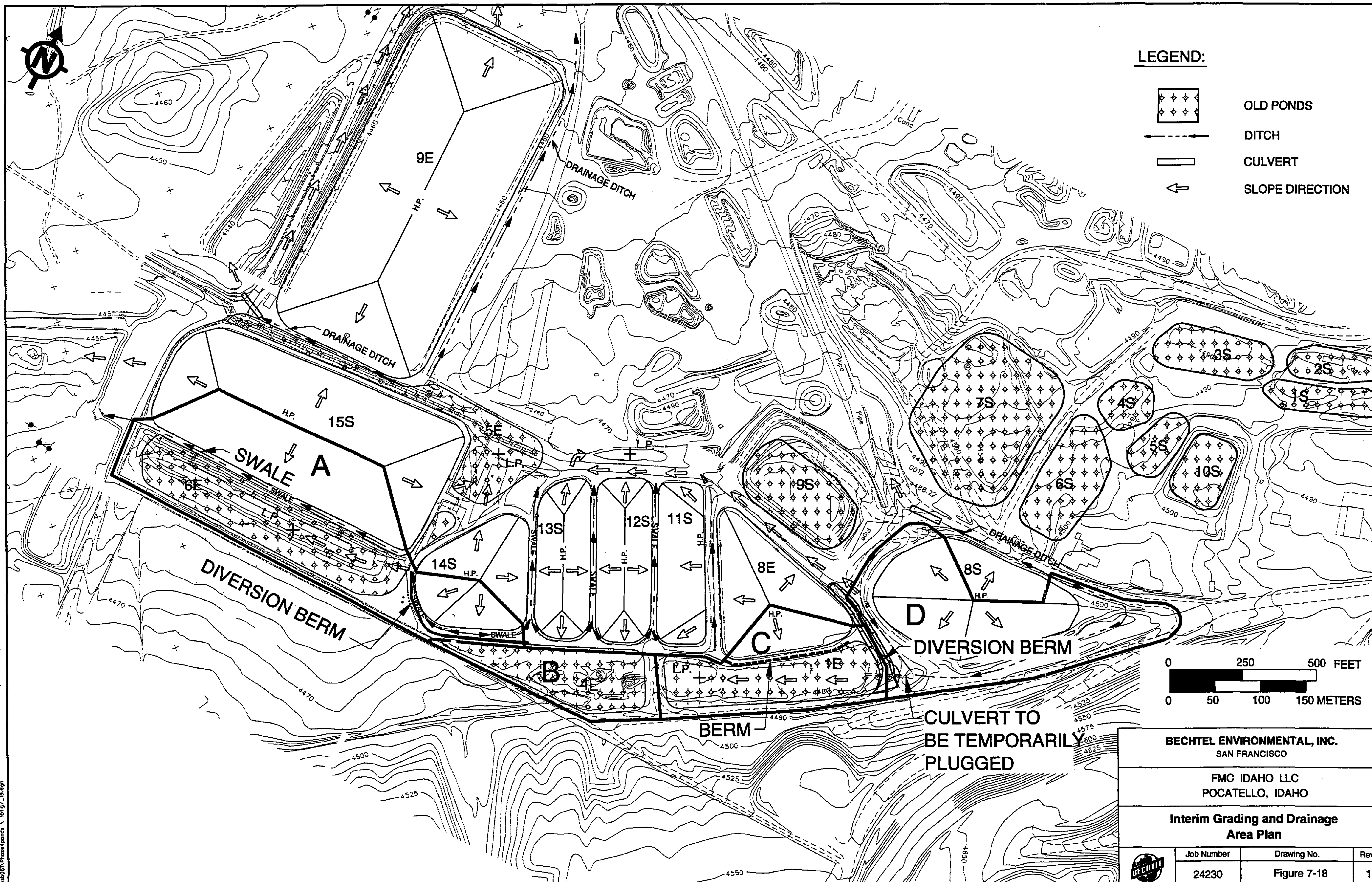
TABLE 7-8
SUMMARY OF SLOPE STABILITY ANALYSES

Case	Minimum Factor of Safety
Static	1.8
Static with 500 psf Crane Load	1.4
Seismic (0.2g)	1.1
Yield Acceleration (0. 27g)	1.0

7.6 STORM WATER MANAGEMENT

Storm water management will consist of perimeter ditches that collect and divert surface run-off away from the closed unit into existing drainage courses. The final cap surface grading is designed at about five percent to facilitate proper drainage. The existing ditches will be improved, if necessary, to accommodate additional run-off resulting from the Phase IV ponds closure area. Each of the Phase IV ponds will be crowned in the middle as shown on Drawings 270-C-213 and 214, Appendix I. The runoff from each of the ponds will drain to their perimeters. Concrete-lined ditches will be installed in between the ponds to collect runoff, diverting the flow to the Phase IV ponds perimeter drainage system toward north of the ponds. The concrete lining will prevent erosion from occurring and damaging the integrity of the final cap. Calculations of ditches and other drainage structures required around the ponds are provided in Appendix M. The perimeter drainage system is shown on Drawing 270-C-212, Appendix I. The overall western pond area drainage requirements and modifications need to be coordinated between the RCRA pond closures and the CERCLA remediation, which will take into account the capping of the western pond area.

In accordance with the Interim Stormwater Drainage Plan for the Western Ponds Area, following placement of the initial fill at the Phase IV ponds, runoff from the temporary caps has been diverted toward the north and westerly direction, away from the old pond areas. Diversion berms, swales were constructed for this purpose during initial fill and temporary cap construction. The completed pond grading and drainage system at the western ponds area meets the intent of the Interim Stormwater Management plan submitted to EPA on May 24, 1999. The plan was modified during construction to eliminate runoff to the south toward old Ponds 1E, 4E, and 6E. Figure 7-18 shows the revised interim grading and drainage plan. The current drainage system as installed in 1999 is described in more detail below. Storm water drainage patterns may change after placement of the final cap and implementation of the CERCLA RD/RA.


LEGEND:
OLD PONDS
DITCH
CULVERT
SLOPE DIRECTION
N
9E
15S
A
SWALE
6E
5E
L.P.
H.P.
DRAINAGE DITCH
DIVERSION BERM
14S
13S
12S
11S
8E
9S
7S
6S
8S
3S
2S
1S
4S
5S
10S
B
C
D
1E
BERM
DIVERSION BERM
CULVERT TO BE TEMPORARILY PLUGGED
0 250 500 FEET
0 50 100 150 METERS
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC IDAHO LLC
POCATELLO, IDAHO
Interim Grading and Drainage Area Plan
Job Number 24230
Drawing No. Figure 7-18
Rev. 1

Two low points were constructed underneath the existing pipe rack north of the Phase IV ponds for stormwater management. One low point was constructed north of the dike common to Pond 11S and 12S and the second low point just north of Pond 13S. Runoff from the east half of the Pond 12S temporary cover combines with runoff from the Ponds 11S and 8E temporary covers and any overflow from south of Pond 8S drains to and through the low point north of the dike common to Ponds 11S and 12S. The runoff from the east section of the Pond 15S temporary cover combines with runoff from Ponds 14S and 13S and the remaining area of Pond 12S, draining north through the low point located just north of Pond 13S.

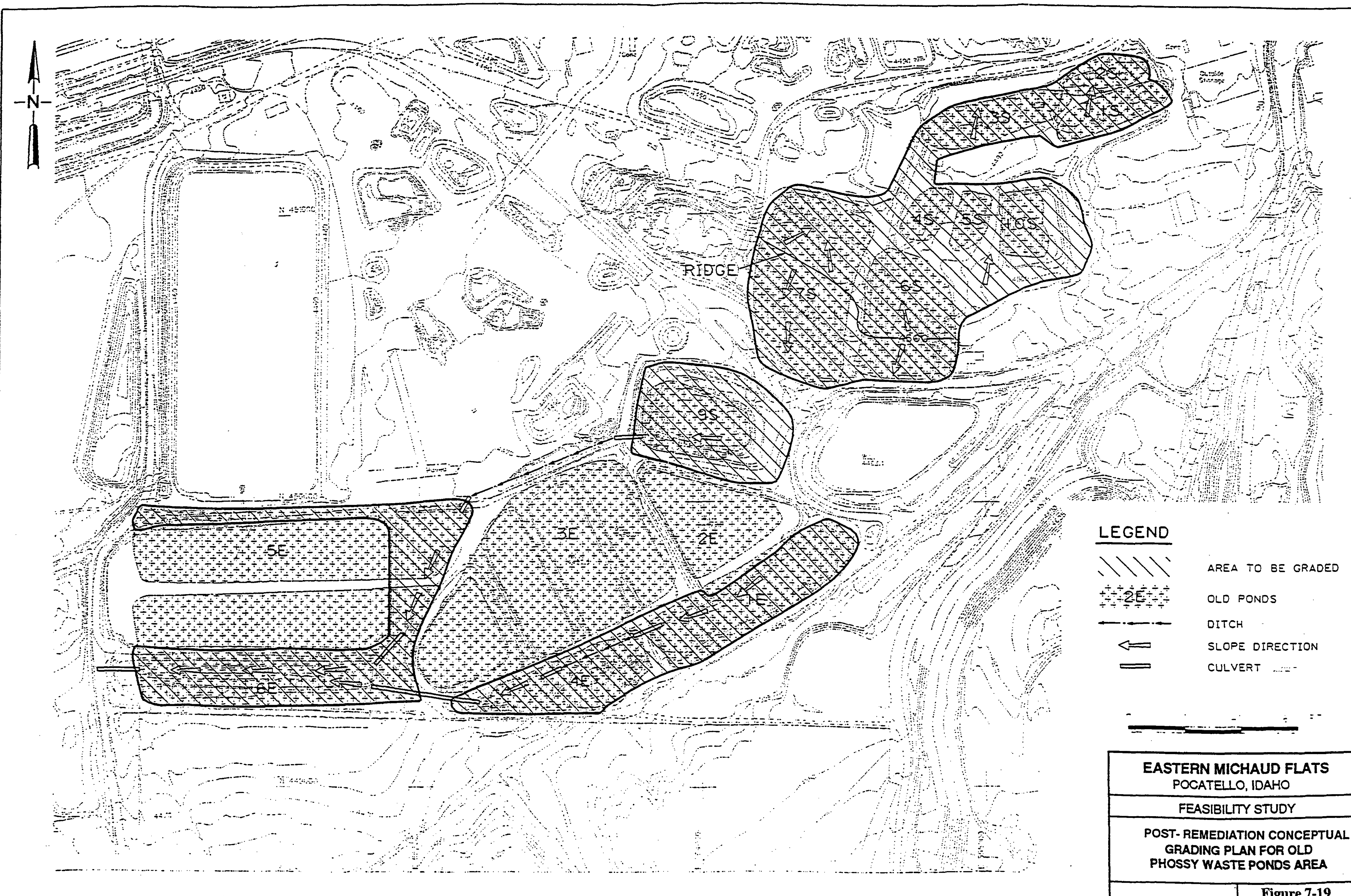
The road south of Pond 11S (south perimeter dike) is higher than the other three perimeter dikes. Runoff from the Pond 11S temporary cover is diverted toward the north by a swale, installed at the north edge of the road adjacent to the south end of Ponds 11S and 12S, and ultimately drains north of the pond area through the low point underneath the existing pipe rack.

Similar to Pond 11S, swales were provided with at the north edge of the south road of Ponds 12S and 13S to divert runoff from these temporary covers to the north through the low points underneath the existing pipe rack.

At Pond 14S, a shallow swale was cut into the north edge of the existing road to divert Pond 14S temporary cover runoff toward the east and west then north to a low point underneath the existing pipe rack north of Pond 13S.

Figure 7-18 depicts the current drainage pattern at the RCRA pond closures and adjacent areas based on the completion of the construction of final covers over Ponds 8S and 9E, and the initial fill and temporary cover over Ponds 15S, 8E, and the Phase IV ponds. This is an intermediate pattern that will be affected somewhat by the capping of the "old ponds" that will be done during the CERCLA RD/RA. As shown on the figure, the temporary drainage configuration maximizes, to the extent practicable (prior to the implementation of the CERCLA remedy), drainage toward the north and away from old Ponds 1E, 4E, and 6E.

An overall conceptual drainage plan for the pond areas, including the areas of the old ponds, is shown on Figure 7-19. This conceptual plan represents the overall drainage pattern of the RCRA ponds after all pond solids have consolidated to the acceptable limit, and the ponds, including the



EASTERN MICHAUD FLATS
POCATELLO, IDAHO

FEASIBILITY STUDY

POST- REMEDIATION CONCEPTUAL GRADING PLAN FOR OLD PHOSSY WASTE PONDS AREA

Figure 7-19

CERCLA old ponds, are capped with a final cover constructed conforming to the EPA approved closure plans and CERCLA remedial designs.

The closure plan has been revised to include the interim stormwater management system constructed in 1999 after the installation of the temporary cap.

7.7 STABILITY OF FINAL COVER AND COVER EROSION

7.7.1 Stability of Final Cover

The proposed final cap consists of topsoil, slag, gravel, sand, geotextile, geonet, HDPE membrane, and a geosynthetic clay liner over a bedding layer of sand. The internal stability of the cap will be controlled by the strength of the bentonite present in the geocomposite liner and bentonite's effective coefficient of friction, which is the lowest of all the cap components. The effective coefficient of friction of the bentonite is approximately 12 degrees. The cap will be constructed to a maximum surface gradient of 5 percent (3 degrees). Thus, the cap will have a factor of safety against internal sliding of approximately four (tan 12°/tan 3°).

7.7.2 Cover Erosion

The potential for erosion losses due to rainfall and wind for the Phase IV ponds RCRA cap cover was evaluated to assess the adequacy of the proposed design. The average annual and peak daily (100-year return period) rainfall erosion rates were estimated using the Universal Soil Loss Equation (USLE) and Modified Universal Soil Loss Equation (MUSLE), respectively. The USLE is an empirical equation developed by the National Runoff and Soil Loss Data Center, which was established by the Science and Education Administration in cooperation with Purdue University, to estimate long-term soil losses due to rainfall. The average annual wind-induced soil losses were estimated using the Wind Erosion Equation, which is an empirical equation similar to the USLE. Details of the analysis are included in Appendix M.

A summary of the estimated erosion losses due to rainfall and wind are presented in Table 7-9. The annual rainfall erosion is estimated to be 0.9 ton/acre or about 0.0046 inch. Over a period of 500 years, the service life of the cap, the rainfall erosion is expected to be about 2.3 inches. Rainfall erosion due to short-term events (100-year, 24-hour storm) is about 0.0017 inch. Since the occurrence of such extreme events is rare, their contribution to the long term annual average is minimal.

The annual wind erosion is estimated to be 1.3 ton/acre or about 0.0068 in. Over a period of 500 years, this value corresponds to 3.4 inches.

TABLE 7-9

SUMMARY OF RAINFALL AND EROSION LOSSES

	PEAK DAILY[1]	AVERAGE ANNUAL[1]		SERVICE LIFE OF CAP[2]
	(IN)	(TON/ACRE)	(IN)	(IN)
RAINFALL EROSION	0.0017	0.9	0.0046	2.3
WIND EROSION	NC[3]	1.3	0.0068	3.4
TOTAL EROSION	-	2.2	0.0114	5.7

[1] (100-YEAR RETURN PERIOD)
[2] SERVICE LIFE OF CAP IS 500 YEARS
[3] NC- NOT CALCULATED

As indicated in Table 7-9, the anticipated total topsoil erosion loss for 500 years is calculated to be approximately six inches. However, it will be difficult to correlate observed short term losses to long term soil erosion projections. To monitor the topsoil layer thickness, 19 topsoil thickness indicators will be installed over the cap area at approximately 100 to 150 foot grid. The indicators will be 2-inch diameter steel pipes welded to steel plates embedded in blocks of concrete (Detail 2, Drawing 270-C-219, Appendix I). The concrete will be placed on top of the sand filter layer just beneath the topsoil layer. Two reference levels will be marked on the pipe. The top level will indicate the top of the initial installed thickness of the topsoil layer and the lower level will indicate the maximum anticipated erosion of the topsoil layer (6 inches after 500 years). The indicators will be inspected annually and the amount of erosion noted and evaluated. When the amount of erosion reaches 5 inches at 50% of the stations, the total cap area will be reevaluated. Depending on the actual observed erosion rate as compared to the calculated rate, topsoil will be added as required and revegetated. This monitoring in combination with routine post closure inspection and maintenance activities as described in Section 10 for localized erosion repair and reseeding, will ensure that the topsoil layer continues to meet the design requirement.

7.8 CONSTRUCTION DRAWINGS, SPECIFICATIONS, AND ANALYSES

Appendix I of this closure plan includes a CQA plan, construction drawings, data sheets, and specifications. In addition, supporting calculations and analyses for pond settlement and the associated stresses on the cap materials, surface water management controls, wind and rainfall erosion, and dike structural integrity are included in Appendix M.

Closure Procedures

This section describes in detail the closure activities conducted to date and future procedures to be implemented at the Phase IV ponds, including site preparation, backfilling, equipment decontamination, monitoring activities, and cap installation.

Closure activities at the Phase IV ponds were initiated in the second quarter of 1999 after notifying and obtaining concurrence from EPA for the initial fill. Closure activities conducted to date included the following:

- Installed geofabric filter and dewatering piping on top of pond solids.
- Pumped out water, placed initial fill of sand and slag, and installed wick drains and the temporary dewatering pumping system.
- Installed temporary settlement monuments and a temporary cover over the initial sand and slag fill.

Future planned closure activities include the following:

- Monitoring and reporting on subgrade settlement (ongoing).
- Flush and remove pond dewatering piping.
- Dispose of waste per Section 8.10.
- Prepare final subgrade for installation of final cap.
- Place final cap and install temperature, pressure and drainage monitoring systems.
- Place permanent settlement monuments.
- Certify closure and install warning signs.
- Complete and submit a survey plat.
- Initiate post-closure care and monitoring.

8.1 MOBILIZATION

Upon EPA approval of the initial fill into the Phase IV ponds and before any closure activities began at the site, the following work was completed:

- Designated field personnel received appropriate hazardous waste training, consistent with applicable Federal Occupational Safety and Health Administration regulatory requirements.
- All utilities were located and marked by FMC or the utilities' owner.
- A preconstruction site visit was made by FMC and the Contractor to inspect all surface structures and to agree on the major items to be cleared, relocated, or removed to accommodate the closure activities.
- Construction laydown areas were designated.
- The exclusion zone (EZ), contaminant reduction zone (CRZ), and support zones were identified and clearly marked as described in the Health and Safety Plan (Appendix G).
- Temporary storage areas were designated for contaminated materials. Any required drums, tanks, or roll-off bins were brought on site.
- The disposal facilities and protocols were specified by FMC.
- Site preparation, including clearing the site of debris and plant growth, were completed to establish access to the closure area.

Similar procedures will be followed before future closure activities (subsequent to approval of this Closure Plan) begin at the site and EPA is notified as per 40 C.F.R. § 265.112(d)(1).

8.2 WATER REMOVAL

Waste within the Phase IV ponds consists of pond solids, which will remain, and water, part of which was removed during backfilling and part of which was and will continue to be removed during pond consolidation. The depth of the wastewater varies in each of the ponds and the approximate volumes occupied in each pond are summarized below:

Pond	Wastewater Depth (feet)	Wastewater Capacity (acre-feet)
11S	0.5	1.0 acre-feet
12S	0.5	1.0 acre-feet
13S	10 - 11	10.4 acre-feet
14S	12 - 12.5	18.3 acre-feet

The inside slopes of the pond dikes were initially covered with sand to preclude possible exposure of pond solids to the atmosphere as the water level in the pond was lowered, with the exception Pond 14S, where the perimeter of the pond and the inside slopes were first backfilled and covered with coarse slag. This procedure was monitored by field personnel to ensure that an adequate level of water was maintained in the pond at all times until all pond solids were covered with fill material.

During the initial fill placement, every effort was made to keep the pond solids covered with water to prevent their exposure to the atmosphere and thus prevented the oxidation of elemental phosphorus present in the pond solids. A 2-inch PVC water level marker was driven into pond sludge near the shoreline of each pond prior to the start of initial sand fill. These water level markers were used to monitor water levels during the early stages of sand fill. Excess water, not required to prevent oxidation of pond solids, was pumped out of the pond using 3-inch and 4-inch portable dewatering pumps. Once sand cover was placed over the entire surface of the pond solids and all surface water was removed using the portable pumps, additional water was removed from the pond using portable pumps connected to the installed dewatering system which pumped from the 2-inch pipes inserted into the 6-inch perforated drain lines. Later, dewatering was performed using the temporary surfaced mounted pumps. The dewatering was performed to minimize the potential for and duration of exposing the unlined portion of the perimeter embankments to raised water levels resulting from placement of the sand fill. Dewatering using the 2-inch pipe inserts was performed on all Phase IV ponds except for Pond 14S after initial surface water dewatering. It was determined, after the 2-inch pipe insert for Pond 14S was connected to a vacuum pump and the pump did not discharged any water from the installed drainage pipe via the pipe insert, that the water level inside Pond 14S is at or below the drain pipe and no further dewatering is required for the pond.

As described above, the protective volume of free water was eventually replaced with sand backfill. As experienced during the initial filling of the Phase IV ponds, the sand fill provided the necessary cover to ensure that the pond solids do not come in contact with the atmosphere. The water pumped out of the Phase IV ponds before the December 31, 2001 expiration of the LDR case-by-case extension was transferred to an onsite RCRA MTR surface impoundment.

8.3 PIPE REMOVAL AND EQUIPMENT DECONTAMINATION

After sufficient wastewater is pumped out of the pond, the pipes within the closure area will be removed. An equipment decontamination area for the Phase IV ponds closure was constructed following the procedures described in Section 8.3.2.

8.3.1 Pipe Removal

With the exception of the leak detection system piping and the piping used for dewatering during consolidation, all other pipes exclusively connected to the unit will be flushed and removed.

The surface of the pipes will be washed using water and, if necessary, industrial phosphate-free detergent. Washing will continue until the wash water is visibly "clear." The surface of the pipe will then be inspected for localized stain and discoloration markings. These marks will be scraped and wiped clean using a wire brush or an industrial broom. The surface will then be cleaned with steam or hot water and inspected before salvage or disposal. Pipe flushing and washing operations will be conducted with water, and in accordance with the decontamination procedures contained in Section 8.3.2 below. This process will be repeated for the pipes used for dewatering.

Excavated areas will be inspected, backfilled, and raised to original grade. Excavation outside the LFC is not planned; however, any elemental phosphorus encountered during excavation outside the limits of the final cap will be mapped, recorded, and reported to EPA.

8.3.2 Equipment Decontamination

Equipment (and personnel) will be decontaminated at designated decontamination area(s) in accordance with Section 6.3 and the H&S Plan (Appendix G). The decontamination area(s) will be installed on a durable, impermeable geomembrane that is resistant to chemical substances and capable of collecting decontamination water and debris.

Galvanized tubs, shallow tanks, pumps, and special berms may be required to collect and contain the decontamination effluent. The decontamination area(s) will be isolated from the other areas by temporary fences, partitions, ribbons, or rope. At the end of the closure activities, decontamination area(s) will be decontaminated, dismantled, and disposed of as specified in Section 8.10.

Equipment used to date was decontaminated using the following procedure:

1. Remove large particles and solids with hand shovels or similar tools.
2. Steam clean or high-pressure water wash, with water and, if necessary, industrial-grade phosphate-free detergent, all equipment surfaces that have contacted waste.
3. Appropriately dispose of washwater and other waste generated by the decontamination as specified in Section 8.10.

These procedures will be repeated when the final cap is installed.

8.4 VERIFICATION OF DECONTAMINATION MEASURES

To verify the effectiveness of decontamination, surfaces of the decontaminated materials/equipment will be visually inspected to confirm the presence of a "clean debris surface" pursuant to the hazardous debris rule discussed in Section 6.3. If these criteria cannot be met, the decontamination process may be repeated or the materials/equipment will disposed of as outlined in Section 8.10.

Equipment/materials determined to be decontaminated (i.e., have a "clean debris surface") will be given an additional final rinse with distilled or de-ionized water. Samples of the final rinsate will then be analyzed in accordance with the Field Sampling Plan for Equipment Decontamination Confirmation (FSP) (see Appendix E of this Closure Plan) to verify the effectiveness of decontamination.

8.5 INSPECTION AND DOCUMENTATION

Cleaned surfaces of decontaminated equipment will be visually inspected by the Project Manager. Final inspection and approval of decontamination will be documented by the Project Manager. The documentation will be used for the closure certification.

8.6 GRADING AND BACKFILLING

A minimal amount of cut and fill is required around the perimeter of the Phase IV ponds to achieve the design subgrade elevation (DSE), which is defined as the elevation at the top of the subgrade immediately underlying the final cap (as shown on Drawings 270-C-213, 214, 216, 217 and 218 in Appendix I).

Some excavation may be necessary to remove any existing facilities. Grading activities are described in Section 8.6.1. Some amount of backfilling is required outside the pond. The majority of the backfill will consist of the initial backfill as described in Section 8.6.2.

8.6.1 Grading and Excavation

Grading will be conducted in accordance with the final design/construction drawings developed on the basis of the DSE. Grading is designed to prevent cutting or excavating the dikes which may contain elemental phosphorus. This is to prevent unsafe excavation activities which may expose elemental phosphorus. Nevertheless, some excavation on high points of the dike and adjacent to the dike may be required which will be performed by a qualified and trained crew in accordance with the Health and Safety Plan (Appendix G). In addition to the excavation required for rough grading (cutting), some "specific excavation" may be necessary in areas where the closure plan calls for removal of the existing facilities . These specific excavation activities will be coordinated with the rough grading excavation.

The excavation areas will be protected against run-on and run-off from precipitation; this may be accomplished by covering the area with plastic sheeting, as needed, and/or providing proper grade. Any water accumulated at the bottom of excavation areas as a result of run-off, run-on, or seepage will be pumped out and disposed of as described in Section 8.11. The perimeter of the specific excavation areas will be sloped such that any run-on will be directed away from the excavation area. All excavation areas will be properly marked and roped off to prevent accidents as described in the Health and Safety Plan.

Specific excavation areas will be inspected by the Construction Quality Assurance (CQA) Officer in conjunction with the Project Manager before these areas are backfilled. The inspection will be conducted to verify the limits and extent of the excavation. The activities related to the excavation will be recorded in the logs of the Project Manager/CQA Officer. These areas will be backfilled immediately after the Project Manager's approval.

After completion of the backfill operation in the specific excavation areas and rough grading activities outside the pond area, the subgrade surface will be inspected by a Registered Professional Engineer for elevation controls and verification of compliance with the specifications prepared on the basis of this closure plan.

8.6.2 Backfilling

Two main types of backfilling operation are distinguished for this plan: general backfill and initial backfill. The material types and fill placement techniques for the two types of backfill are different as described in this section. General backfill refers to the backfilling operations outside the pond, including the specific areas excavated for removal of any pipes and other similar structures. Initial backfill refers specifically to the backfill placed in the pond extending from top of the pond solids to below the final cap.

8.6.2.1 General Backfill

Material type and placement of the backfill will be in accordance with the following requirements. Slag will be used as general backfill, and will be placed and compacted in lifts as specified in the technical specifications (Appendix I). Slag will be crushed and processed as described in Section 7.2.6 prior to placement.

Excavation areas will not be backfilled until the Project Manager or CQA Officer has given approval for backfilling operations.

8.6.2.2 Initial Backfill

Field activities conducted at Pond 8S were used in the determination of the backfilling methods for the Phase IV ponds. The following activities were performed after notifying and obtaining concurrence from EPA:

- Initial fill at Pond 8S using controlled placement techniques with conveyor-type placement equipment; and
- Geotechnical investigation of Phase IV ponds sludge properties.

The initial fill was successfully completed, upon EPA approval, into and over the Phase IV ponds using the controlled placement techniques developed from the above experience and test results.

These field activities are described in further detail below.

Initial fill at Pond 8S. Shear vane tests carried out at Ponds 8S and 15S in November 1993, indicated the sludges at these two ponds are very soft. The initial filling at Pond 8S provided more information on the behavior of the pond solids and indicated that these pond solids behaved better than originally anticipated considering their in-situ shear strengths (BCI, 1994).

Investigation of Phase IV Ponds Sludge. Sampling and special laboratory geotechnical testing were performed during the third quarter of 1997 on Phase IV ponds sludges to verify its physical characteristics for development of the closure procedure and filling method. Field sampling and testing included collecting sludge samples and performing in-situ vane shear testing at various locations and depths in the ponds. Detailed procedures and test results are included in "Field Geotechnical Investigation, FMC Corporation", prepared by BCI, August 1997 (Appendix K). The laboratory tests included moisture content, gradient ratio, specific gravity, Atterberg Limits, hydrometer/gradation, and one-dimensional consolidation to evaluate the sludge behavior and consolidation characteristics of the proposed fill. Detailed procedures and results of the laboratory testing are included in Appendix L.

The Phase IV ponds sludge exhibited similar strengths as the Pond 15S sludge; therefore it was concluded that the Phase IV ponds could be backfilled in the same fashion with conveyor-type placement equipment/system and controlled placement techniques.

Placement of Initial Fill. Drawings for the initial filling of the Phase IV ponds are presented in Figures 7-5 through 7-12. Placement of the initial fill, which commenced on April 27, 1999, consisted of the following principle activities:

- Staging and seaming the geofabric filter.
- Attaching the drainage/dewatering piping and deploying the fabric.
- Placing sand to anchor fabric around perimeter of the unit.
- Placing sand using a SuperSpan conveyor system developed by Rotec, Inc.

- Placement of geoweb and a thin cover of sand and gravel using lightweight equipment.
- Installing wick drains to accelerate consolidation of pond solids in Ponds 11S and 12S.
- Placing slag fill.
- Placing settlement reference points.
- Placing temporary cover.
- Installing a dewatering pumping system, except for Pond 14S, which exhibited an absence of water in the drainage piping for removal.
- Monitoring of settlement.

The construction activities related to initial filling were completed in the early part of the fourth quarter of 1999.

Geofabric and Drainage Piping. A special geofabric, Nicolon/Mirafi GC1000, was selected for Ponds 11S, 12S and 13S, as testing indicated that the pond solids in these ponds were much weaker than those in Pond 8S. The GC1000 fabric is lighter than water, has a minimum grab strength of 1,000 pounds per inch, and a minimum seam strength of 600 pounds per inch. The fabric was placed using procedures similar to those used at Pond 8S. The fabric was shop-fabricated into manageable pieces, shipped to the site, and sewn together with specialized portable sewing machines to create one large piece of fabric for each pond. After the field seams were completed, the fabric was arranged into accordion folds for deployment over the unit. The fabric for Ponds 11S, 12S and 13S was deployed after the inside slopes of the ponds were covered with a layer of sand to prevent exposing any phosphorus material to the atmosphere and to reduce interface friction between the fabric and the existing gravelly surface.

The fabric was deployed across each pond by attaching pull lines and floats to the leading edge, then pulling using construction equipment and personnel operating along the sides and leading end of the pond. Deployment started at the southeast shore for each pond. The fabric for each of the ponds was fabricated with extra width to allow anchorage along the surrounding dikes with sand ballast.

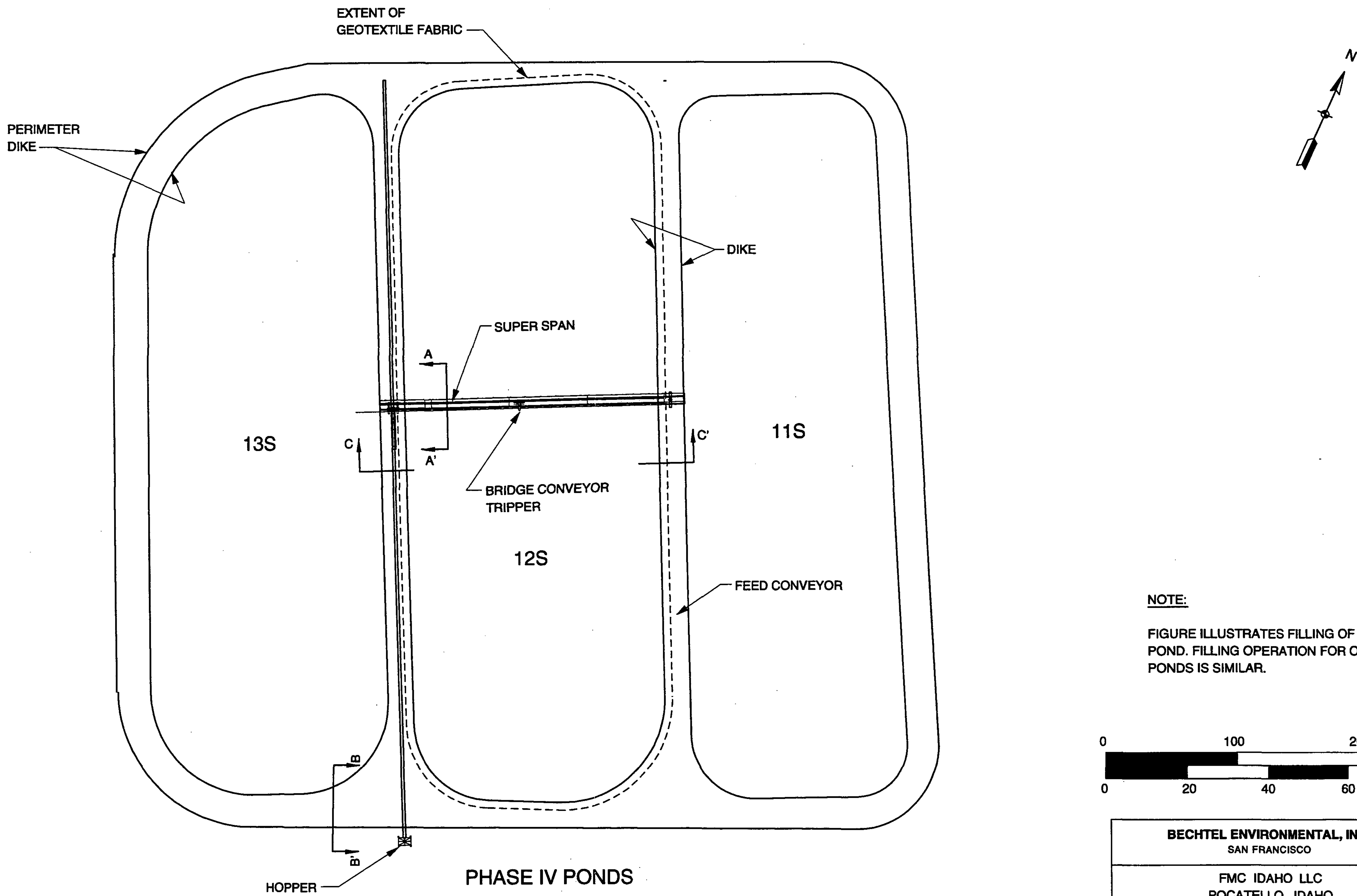
The pond drainage collection piping, consisting of 6-inch HDPE perforated, corrugated drainage piping (with filter fabric socks fitted over their exterior) and 2-inch HDPE pipe inserts, were directly tied to the top of the fabric of each pond during deployment. The drain pipes were spaced along the pond length at about 64-foot intervals. This installed drainage system was used to remove water from the unit during initial fill placement and will be used for future dewatering to accelerate settlement.

Pond 14S Perimeter Slag Fill and Initial Sand Fill. Because of the thin sludge layer, Pond 14S was initially backfilled with coarse slag around its perimeter, pushing the sludge to a central area about 100 feet in diameter, thereby minimizing the use of the conveyor-type placement equipment. Three layers of Amoco 2002 woven geofabric were placed over the remaining Pond 14S sludge, followed by about 3 to 4 feet of sand and fine gravel placed using a Putzmeister Telebelt conveyor system. The Telebelt is a truck-mounted extendable conveyor with minimum and maximum boom lengths of 36 feet and 105 feet, respectively. The boom is capable of rotating a full 360 degrees. The deflector hood (used for concrete pours) at the end of the boom conveyor was removed to allow material to be projected off the end of the conveyor. Generally, another 10 to 15 feet of additional reach was achieved, enabling material placement to extend to about 117 feet from the pivot point. The boom conveyor is fed via a 35-foot long feed conveyor with a truck hopper that controls the rate of material placed on the feed conveyor belt. The truck hopper was fed by a free-standing 5-cubic yard hopper with a 10-foot by 6-foot top opening which received material from a front-end loader equipped with a 2.5-cubic yard bucket. The remaining fill was consisted of slag placed using conventional earthmoving equipment as described below.

Prior to the placement of the geofabric and the initial layers of sand fill over its central portion, a ramp and working platform were constructed inside Pond 14S using coarse slag placed by end-dumping from the hauling equipment and spreading with bulldozers. The working platform, was extended around the pond perimeter and widened toward the center of the pond. Pond 14S initially contained approximately 1 foot of sludge. By placing the slag in this manner, the sludge was displaced toward the center of the pond without causing the sludge to be exposed to the environment and atmosphere. Adequate water was left in the pond to prevent exposure of the pond solids to the atmosphere. Filling the pond from the perimeter with slag had reduced the reaches required by the conveyor placement equipment and thereby accelerated the pond backfilling operation.

Sand Fill. The initial layers of sand fill for Ponds 11S, 12S, and 13S were placed in controlled lifts directly on top of the fabric using the SuperSpan conveyor system, supplied by Rotec Industries. The initial sand fill plan and section A-A' are shown in Figures 8-1 and 8-2. The SuperSpan consists of a 24-inch wide conveyor system supported by a 240-foot truss that spanned the pond width. Fill material was distributed across the pond width by a moving tripper which traveled and dropped material along the truss conveyor. The truss was supported and positioned by track crawlers located on either end of the truss. The truss conveyor system was fed by a main feed conveyor located along one side of the pond which transferred fill material from one end of the pond to the truss conveyor via a tripper that moved with the truss. Fill material for the main feed conveyor was placed through a hopper which was filled using a front end loader. A fill material stockpile located near the hopper was supplied by dump trucks and shaped by bull dozers.

The SuperSpan was capable of controlling the thickness of material placed for any given pass across a pond by varying either the feed opening at the hopper and/or the velocity of the truss tripper across a pond. Electronics designed into the SuperSpan conveyor system were capable of recording the rates and amounts of material placed.



PHASE IV PONDS

NOTE:

FIGURE ILLUSTRATES FILLING OF ONE POND. FILLING OPERATION FOR OTHER PONDS IS SIMILAR.

0 100 200 FEET

0 20 40 60 METERS

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO LLC POCATELLO, IDAHO		
Phase IV Ponds Initial Sand Fill - Plan		
Job Number	Drawing No.	Rev.
24230	Figure 8-1	1

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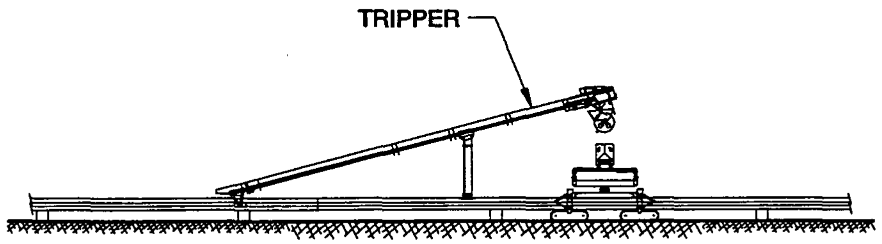
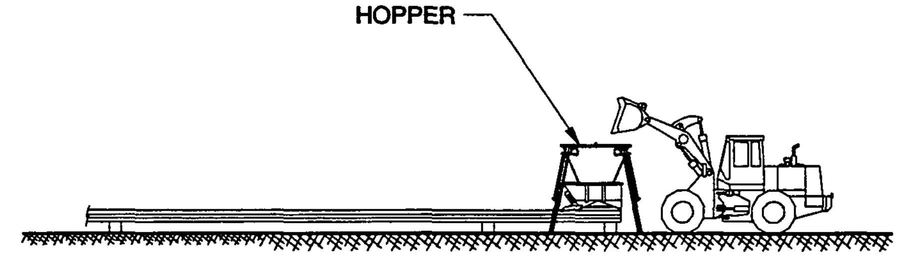
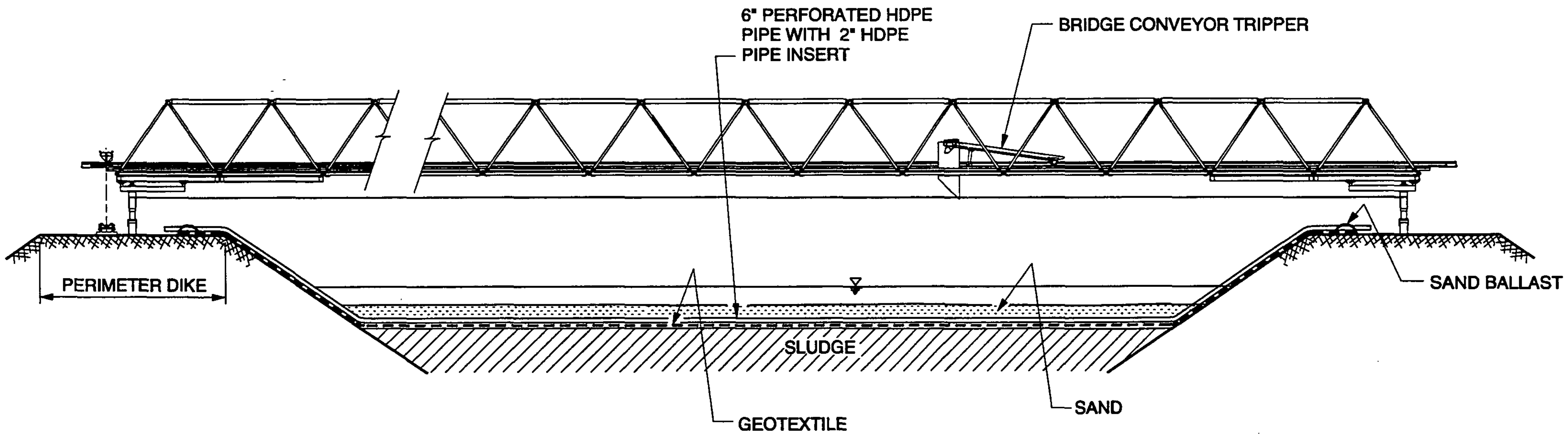


SECTION A-A'
NTS



SECTION B-B'
NTS



SECTION C-C'
NTS

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BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO LLC POCATELLO, IDAHO		
Phase IV Ponds Initial Sand Fill - Sections		
Job Number	Drawing No.	Rev.
24230	Figure 8-2	1

To prevent the creation of mud waves resulting from unequal loading of the soft pond sludge, the distribution of the sand fill material was controlled by the fill lift thickness and the spacing between adjacent rows of fill laid down by the SuperSpan. Fill material placed with the truss tripper resulted in a strip of fill approximately 4 feet wide. Therefore, to provide a complete coverage over the pond, a spacing of 4 feet between the center of adjacent fill strips was required. During the first three lifts, the fill strips were placed at 8 feet spacing and required two full pond passes with the SuperSpan (with an initial offset of 4 feet at the start of the second pass sequence) to provide a complete lift coverage. Each pond was filled using the following lift sequence: one 6-inch lift (8-foot spacing), one 9-inch lift (8-foot spacing), one 12-inch lift (8-foot spacing), followed by three 12-inch lifts (continuous, placed at 4-foot spacing). Due to the greater-than-anticipated depth of water present in Pond 13S, an additional 12-inch lift was placed in this pond to reduce the potential for any construction delays resulting from inadequate access to the pond surface by heavy construction equipment. After the sand was placed (about 5 to 6 feet) and the water level in the pond was adequately lowered, the fill surface was capable of supporting conventional types of construction equipment to complete the filling operations.

Following placement of the sand, LGP dozers and wide track backhoes were used to smooth the sand surface and add a fine slag/gravel surfacing layer to support the wick drain installation equipment and other construction equipment. A layer of geoweb was also installed in Ponds 11S, 12S, and 13S at the completion of sand placement with the SuperSpan to increase the supporting strength of the fill for the heavier earth-moving equipment used to complete the filling operations.

<u>Wick Drains.</u> Wick drains promote the upward movement of water from the pond solids into the dewatering collection piping. Prior to the installation of wick drains in Ponds 11S and 12S, the pond surface was smoothed to provide a relatively level working surface for wick drain placement.

The wick drains were Nilex Mebra-Drain® Product No. MD88. A total of approximately 1,100 wick drains were installed at about 12- to 13-foot depths in a 7-foot center-to-center, triangular spacing pattern within Ponds 11S and 12S. The wick drains were installed using a specialized mandrel device mounted on a CAT215 backhoe. The mandrel device was equipped with a decontamination system consisting of a rubber wiping sleeve and an automatic washwater spraying unit that cleansed the mandrel end with water as the mandrel was withdrawn from the ground. In addition, a portable hand spray unit supplied via plumbing to a water truck was also used by the operators to further cleanse the end of the mandrel as it was withdrawn.

The mandrel pushed the wick drains through the gravel/fine slag surfacing layer, sand fill, geoweb, fabric, and pond sludge, and terminated about 3 feet above the pond bottom to prevent penetration through the existing bottom lining system. As the mandrel was withdrawn from the sand and sludge, the rubber wiping sleeve and water sprayers were used to wash away any sludge that may have adhered to the mandrel. This procedure reduced the potential for sludge to be bought out of the pond and exposed to air. Due to the variability in liner elevation near the pond edges, the aerial extent of the wick drain coverage was reduced to include only the central portions of Ponds 11S and 12S.

Slag Fill. Following completion of the wick drain installation, 12-inch minus slag fill, obtained from FMC plant stockpiles, was placed directly on the fine slag/gravel surfacing layer. The slag was hauled, placed, and spread in approximately 1- to 2-foot thick layers to prevent mud waves from forming in the underlying sludge material.

Each pond was backfilled with slag to the design levels to load and consolidate the underlying pond sludge. This procedure will also minimize future settlement caused by the final cover. The initial fill was crowned at the center of the ponds and sloped to the pond perimeters. The slopes were constructed to provide proper drainage throughout the sludge settling period.

Temporary Cover. A 40-mil thick HDPE geomembrane was placed over a 6-inch layer of imported sand bedding material. The HDPE membrane was placed over the Phase IV ponds and field-welded into one piece over each pond. Collars were welded onto the membrane and fitted and sealed around the 2-inch dewatering pipes and the water level monitoring pipes (observation wells).

The following summarizes the design criteria and completed construction activities for the temporary cover over the Phase IV ponds:

- To provide a low permeability membrane that prevents water infiltration into the pond fill, a HDPE liner of 40-mil thickness was used. The liner material supplied was tested in a laboratory for thickness, tensile properties, tear resistance, puncture resistance and specific gravity to ensure that the material furnished conformed to the design requirements. The manufacturer of the liner material, National Seal Company, was also the installer. The manufacturer/installer had more than 10 million square feet of HDPE liner manufacturing and installation experience. The liner was welded into a single, continuous sheet using heat fusion by manufacturer-authorized qualified installers who have had at least one year of HDPE geomembrane installation experience while working under a supervisor who has been responsible for installing at least 250,000 square feet of HDPE geomembrane. All welders were required to successfully perform a minimum 6-foot warm-up weld each day prior to commencing welding for the day. All welded seams were non-destructive tested using air pressure testing. Areas that failed the test were repaired and the welded seams retested. The geomembrane installation was accepted only after all areas passed the test. Properly fitted boots or sleeves, prefabricated at the manufacturer plant, were welded to the liner, sealed, and clamped at penetrations of the liner with stainless steel clamps. The liner was placed on a surface prepared for receiving the geomembrane; this surface consisted of a sandy material with no particle larger than 3/8-inch in size and was compacted with 3 coverages of a vibratory roller to a minimum 6-inch-thick layer. This bedding material was inspected to ensure that the surface was smooth and without sharp objects that could penetrate the liner. The prepared surface was also inspected and subsequently accepted by the liner installer prior to liner installation. The liner was then anchored at the perimeter with an anchor trench and trench backfill.

- To prevent wind uplift and potential damage, the surface of the geomembrane was weighed down with sand bag ballast placed in a 10-foot grid pattern and the sand bags were tied together in one direction to prevent sliding under heavy wind loading.

- To ensure that the temporary cap is able to tolerate the anticipated fill settlement, the selected liner material is a flexible geomembrane that can easily conform to the shape of the surface of the fill material. The maximum anticipated settlement of the pond sludge is up to less than 2 feet after liner installation. The HDPE liner is expected to be in compression when the pond sludge consolidates and, with the sand bag ballast, will conform to the settled surface. The initial fill over the Phase IV ponds was crowned at the middle of each pond at an elevation that is higher than the dike; therefore, the liner will not exceed the initial installation tension, given the range of anticipated settlement. As the experience at Pond 8S indicates, damage has not occurred to the temporary cover from settlement of similar magnitude.

- To meet the minimum temporary cover life expectancy requirement of two to five years, which is the anticipated time required for consolidation of the pond sludge prior to placement of the final cap, the temporary cap material selected is made of HDPE impregnated with carbon black to resist ultraviolet deterioration. Typical commercially available HDPE lining material has an expected service life of 20 or more years under full exposure to the environment. In addition, as described above, conformance testing was performed on the supplied liner material to ensure material properties met the design requirements, qualifications of the liner manufacturer and installer were reviewed and subsequently found acceptable, and a Construction Quality Assurance Officer had reviewed and inspected that proper construction procedures (according to the manufacturer's specifications and use of qualified installers) were followed during the liner installation. Furthermore, the liner will be routinely inspected for damage, anchorage, and ballast. Any damage that might occur to the liner will be promptly repaired to preclude damage propagation.

Dewatering System. A single collection pipe was installed in Pond 14S. After the pond water was removed using temporary portable vacuum pumps, the 2-inch HDPE pipe insert was connected to one of these pumps. The pump was turned on for several minutes, but no flow was detected from the collection pipe and subsequently no dewatering system was installed in this pond. The installed dewatering system for Ponds 11S, 12S and 13S consists of collection pipes, water level monitoring equipment, pumps, discharge pipes, and control systems. Drainage collection pipes were installed and spaced approximately every 64 feet on top on the geotextile fabric. The water level monitoring equipment consists of monitoring/observation wells mounted with associated electronic water level sensing devices. These wells, which penetrate the fill surface to near the top of the geotextile fabric, were installed near the drainage pipes used for dewatering. Four wells were installed in each of the Phase IV ponds except for Pond 14S. Level switches were installed within the wells to control operation of the pumping system. The wick drains and dewatering system were operated and will continue to operate to collect and remove any water during pond sludge consolidation to accelerate the consolidation process.

8.7 TEMPORARY SETTLEMENT MONITORING

Settlement of the initial fill is being monitored prior to the final preparation of the subgrade. During the installation of the temporary cover, 21 monuments were placed at designated locations, as indicated in Section 7.4.7. A schematic of the temporary settlement monuments is shown in Figure 7-14. The temporary settlement monuments were installed just prior to placement of the temporary cover and consist of a square block of concrete with a steel plate. The steel plate lies immediately beneath the FML.

The initial fill settlement monitoring has been initiated, and will continue until the permanent cover is installed. Settlement monitoring consists of taking elevation readings on top of the monitoring plates using a surveying instrument. The positions of the monuments were located in the field and marked on the top of the liner with paint. Should it become necessary, the settlement monitoring plates can be relocated using a metal detector and/or probing with the surveying rod. The accuracy of the elevation readings will have a tolerance of 0.01 foot. The frequency of settlement readings will be once a month; however, they may be taken more frequently initially. The settlement readings will be plotted cumulatively versus time after each of the readings, and superimposed onto the predicted settlement/time curves. Settlement data is and will continue to be compiled and reported on a quarterly basis, or at a longer interval with EPA's approval. The reports will include the following:

- Recorded settlement data in a tabulated format.
- Revised settlement/time curves, showing the measured data superimposed on the predicted curves.
- Revised values of ultimate settlement.
- A revised estimate of when the final cap may be installed.
- A discussion of any problems which may have occurred in the field over the last quarter and the measures taken to correct those problems.

The settlement readings will continue to be obtained until the settlement curve establishes that the settlement rates have stabilized and diminished to an acceptable level. The acceptable rate of settlement for the installation of the final cap, as established in Section 7.4.5, is defined as 1 inch per year subject to analyses of field data.

The observed settlement behavior to date indicates that settlement has generally occurred as predicted, except for a larger-than-predicted amount of initial settlement during placement of the initial sand fill (Astaris 2001c). This initial difference was due to variations in the sludge surface elevation across the pond and to the presence of a very soft, semi-fluid zone of material above the more-solid mass. However, after the initial settlement behavior is excluded, the remaining settlement is following the predicted trend.

8.8 SUBGRADE PREPARATION

The temporary liner will first be removed and properly disposed. The subgrade will then be brought up to the design subgrade elevation (DSE) level which is defined as the elevation at the top of subgrade immediately underlying the cap. While the subgrade over the pond surface area, hereby referred to as the pond subgrade, will consist of re-graded slag fill, the exposed subgrade at the perimeter of the cap will consist mainly of the surface of the existing dike. The area of the exposed subgrade will be limited to the area along the pond perimeter that is within the Limit of Final Cover (LFC) indicated on Drawing Nos. 270-C-213, 214 and 218 of Appendix I.

Minimal or no settlement is anticipated under the exposed subgrade area, while the pond subgrade is expected to undergo further settlement as discussed in Section 7. Therefore, a distinction is made here for preparation of the two subgrades: exposed subgrade and pond subgrade, both of which combine to provide the DSE.

8.8.1 Exposed Subgrade

Little or no compaction is required on the exposed subgrade. Because the surface material of the exposed subgrade is expected to be composed mainly of coarse slag, no density testing is proposed; instead, the surface, which will receive fill, will be compacted with three passes of a vibratory roller having a minimum static weight of 12 tons to establish adequate compaction. Soft spots, if encountered, will be removed and replaced with suitable granular material or slag, and re-compacted.

8.8.2 Pond Subgrade

The pond subgrade will consist of a minimum of 12 inches of well-compacted sandy material immediately below the final cap. Due to the coarse nature of materials specified, no density testing is proposed; only appropriate coverages of vibratory compaction equipment are to be used. The sand layers, referred to as the Liner Foundation and Sand Filter Material in the specifications (Appendix I), will have a minimum thickness of 6 inches each. These layers will be placed on top of the compacted slag surface to act as a uniform foundation bedding layer for the overlying GCL.

8.9 CAP INSTALLATION

After the subgrade settlement is stabilized per Section 7.4, installation of the final cap will be initiated when the weather conditions allow. The construction of the final cap will include placement of any additional fill required to compensate for the settlement, and addition of a fine-grained bedding layer in those areas as necessary to ensure that the overlying geosynthetic clay material is protected from damage.

The material type and placement of any additional fill will meet the requirements of the fill for pond subgrade as described in Section 8.8.2. The various components (layers) of the proposed Phase IV ponds RCRA cap are indicated in Figure 7-2 and the design basis is presented in Section 7. The temperature and pressure monitoring systems are described in Section 7.1.4. The drainage monitoring system is described in Section 7.2.5.

After the material sources and types are selected per detail design requirements, each component of the cap will be installed to achieve the minimum design requirements and comply with the specifications and construction drawings.

At least 17 permanent settlement monitoring monuments will be installed at the Phase IV ponds, at the locations shown on Drawings 270-C-213 and 214 of Appendix I. A typical detail for a permanent settlement monument is provided on Drawing 270-C-219, Detail 1 (Appendix I). The procedure for settlement monitoring during the post-closure period is provided in Section 10.4.

8.10 WASTE DISPOSAL

The wastes accumulated during the closure activities at the Phase IV ponds will consist of decontamination washwater, soil, pipes, construction debris, disposable safety gear, personal protective equipment (PPE), and some geomembranes. Wastes will be stored either temporarily on the premises prior to disposal or shipped directly to appropriate disposal sites in accordance with this section. The following describes waste management practices to be used for wastes generated during closure of the Phase IV ponds.

8.10.1 Temporary Storage

The decontamination water may be temporarily contained in drums or on-site portable vessels. Excavated soil and construction debris may be temporarily stored in dumpsters or bins, prior to disposal. Disposable PPE and safety gear, such as disposable clothing and spent cartridges, will be accumulated in containers with lockable lids. All waste containers will be managed in accordance with applicable RCRA regulations.

8.10.2 Disposal of Liquid Waste

The liquid waste anticipated during closure are from dewatering activities and from equipment decontamination. Wastes from the initial dewatering activities were sent to an onsite RCRA MTR surface impoundment. During the 1999 initial filling operations, water removed from the Phase IV Ponds was sent to Ponds 16S and 18. Water removed by the dewatering systems in 2000 and 2001 was sent to Pond 18. After January 1, 2002, any liquid wastes will be sent to a new on-site water treatment plant or otherwise managed in accordance with RCRA requirements. No listed hazardous waste relating to closure activity is anticipated at the facility. If transportation to a hazardous waste facility is required, hazardous waste manifest procedures will be followed in accordance with 40 C.F.R. § 262.20 for hazardous waste.

8.10.3 Disposal of Solid Waste

Any solid wastes generated as a result of Phase IV ponds closure activities will be disposed of in accordance with applicable RCRA regulations. Any solid waste such as large pieces of equipment that cannot be decontaminated or containerized PPE, will be disposed of in the on-site landfill or an off-site solid waste landfill, if non-hazardous, or at a permitted off-site facility, if hazardous. If transportation to a hazardous waste facility is required, hazardous waste manifest procedures will be followed in accordance with 40 C.F.R. § 262.20.

8.11 CLOSURE INSPECTION/CERTIFICATION

Within 60 days of completion of the closure of the Phase IV ponds, FMC will submit to the EPA Regional Administrator a certification that the pond has been closed in accordance with the specifications in the approved closure plan. The certification (see Section 9) will be signed by an FMC Idaho, LLC Corporate Officer.

FMC will contract with an independent Professional Engineer registered in the State of Idaho to verify that closure of the Phase IV ponds was conducted in accordance with the EPA-approved plan. The Professional Engineer will perform site inspections during closure activities for closure certification purposes, as indicated in Table 8-1, and will sign the closure certification.

In addition, FMC will contract with a professional land surveyor to prepare and certify a survey plat indicating the location and dimensions of the Phase IV ponds with respect to surveyed benchmarks. FMC will file the survey plat and deed notice with the Power County recorder's office and provide a copy to the Regional Administrator no later than 60 days after completion of closure of the Phase IV ponds.

TABLE 8-1
CLOSURE INSPECTION/CERTIFICATION SCHEDULE

CLOSURE ACTIVITY	DAYS AFTER INITIATING FINAL CAP CONSTRUCTION
At completion of preparation of subgrade	35
During GCL placement and at completion	40 and 50
During FML placement, weld testing and completion	55 and 60
At completion of geonet and geofabric installation	70
At beginning, during compaction and completion of installation of slag protective layer	80, 100, and 130
At completion of top soil placement and permanent settlement monuments	180

9 Closure Certification

Closure Certification

Within 60 days of completion of closure of the Phase IV ponds, FMC will submit to the Regional Administrator, by registered mail, a certification that the waste management unit has been closed in accordance with the specifications of the Phase IV Ponds Closure Plan. The certification will be signed by an independent Professional Engineer registered in the State of Idaho. Upon request, documentation supporting the Engineer's certification will be submitted to the Regional Administrator.

The certification of closure activities for the Phase IV ponds will consist of the following statements:

> *I certify, under penalty of law, that the Phossy Water Clarifier Surface Impoundments Ponds 11S, 12S, 13S, and 14S (the Phase IV Ponds), were closed on (date) in accordance with the specifications of the EPA-approved Phase IV Ponds Closure Plan. The closure plan was approved by the Regional Administrator on (date).*

Name: ______________________________

Signed: ______________________________
FMC Idaho, LLC Corporate Officer

Title: ______________________________

Date: ______________________________

Name: ______________________________

Signed: ______________________________
Engineer

Registration #: ______________________________

Date: ______________________________

10 Post-closure Plan

Post-Closure Plan

Post-closure care and use of the property at the Phase IV ponds will be performed in compliance with 40 C.F.R. §§265.117 through 265.120 as described briefly in the following sections. During the post-closure care period, FMC will perform the post-closure monitoring activities in accordance with the applicable performance standards specified in 40 C.F.R. §§265.117, 265.228, and 265.310 which include the following:

- **§265.228(b)(1); §265.310(b)(1):** Requires that the integrity and effectiveness of the final cover be maintained, including making repairs to the cover as necessary to correct effects of settling, subsidence, erosion, or other events.
- **§264.228(b)(2); §265.310(b)(2):** Requires that the leak detection system be maintained and monitored, and other leak detection system requirements be met according to specific criteria.
- **§264.228(b)(3); §265.310(b)(3):** Requires that the groundwater monitoring system be maintained and monitored to comply with 40 C.F.R. Part 265, Subpart F, as applicable.
- **§264.228(b)(4); §265.310(b)(4):** Requires the prevention of run-on and run-off from eroding or otherwise damaging the final cover.
- **§265.310(b)(5):** Requires that benchmarks be protected and maintained per 40 C.F.R. §265.309

Activities to be performed during the Phase IV ponds post-closure care period shall be conducted to ensure that the Owner/Operator complies with the above-specified standards. Post-closure monitoring will be continued for 30 years unless shortened or lengthened by the Regional Administrator in accordance with 40 C.F.R. §265.117. FMC will petition EPA to reduce the post-closure monitoring period in accordance with 40 C.F.R. §265.118(g) in the event the Company concludes that a monitoring period of shorter duration is warranted. The post-closure activities that will be performed at the Phase IV ponds are summarized in Figure 10-1. Table 10-1 summarizes monitoring/inspection activities, records to document monitoring/inspection activities, reporting frequencies, triggers and response actions to be taken. During the post-closure period, information about post-closure activities can be obtained by contacting:

- Remediation Project Director, Pocatello
  FMC Idaho, LLC
  3 miles west of Pocatello on Highway 30
  P.O. Box 4111
  Pocatello, ID 83205
  (208) 236-8200

1. Groundwater Monitoring Wells and Temperature and Pressure Monitoring Systems
FMC will perform periodic sampling and analysis of monitoring wells as specified in the groundwater monitoring program. These wells will include four downgradient wells (104, 114, 131 and 168) and one upgradient well (167). In addition, regular temperature and pressure monitoring as well as additional monitoring as triggered by preset levels and alarms will be conducted.
2. Inspections
FMC will conduct quarterly inspections of the closure area for the first five years, then inspections will be conducted semiannually. Inspections will also occur within 48-hours of each 25-year, 24-hour storm event. Inspections will include the following: vegetative cover, recent rodent or insect activity (such as fresh soil piles or holes), settlement monuments, final cover soil components, ditches, drainage systems, warning signs, security, cap drainage, topsoil thickness indicators, temperature and pressure monitoring system components and groundwater monitoring wells.
3. Maintenance Activities
The closure area will be maintained, as needed, on the basis of the inspection records or as necessitated by unusual natural events, such as severe storms. The required repairs will be performed by FMC Contractors as soon as practical. The maintenance work may include the following: (a) Maintenance of final cover • Replacing lost soil and reseeding • Maintaining drainage channels and culverts • Controlling cover damage, including cracks, excessive settlement, ponding water, low spots, erosion channels, and rodent intrusions • Contingency plans for damage caused by severe storms or natural events (b) Maintenance of monitoring systems • Monitoring well repair or replacement • Maintenance or repair of settlement monuments • Maintenance or repair of topsoil thickness indicators • Maintenance or repair of temperature monitoring system • Maintenance or repair of pressure monitoring system components (c) Maintenance of security systems • Warning signs • Fencing

FIGURE 10-1
POST-CLOSURE ACTIVITY CHECKLIST FOR THE PHASE IV PONDS – FMC, POCATELLO, IDAHO

Table 10-1
Post-Closure Activity Checklist

Post-closure Monitoring/Inspection Activity	Record/Report	Activity Frequency	Reporting Frequency *	Trigger(s)	Action(s)	Closure Plan Reference
Groundwater monitoring						
Quarterly monitoring	Quarterly data validation report	Quarterly	Quarterly	See IS GW monitoring plan	See IS GW monitoring plan	Sections 4 & 5; Attachment 10-1
Annual groundwater assessment	Statistical evaluation, and Annual Assessment Report	Annually	Annually	See IS GW monitoring plan	See IS GW monitoring plan	Attachment 10-1
Quarterly inspections						
Cap and cover	Inspection log	Quarterly	Annually	Visual or electronic indication of degradation or damage	Repair or replace as soon as practical	Section 10
Monuments	Inspection log	Quarterly	Annually			
Drainage systems	Inspection log	Quarterly	Annually			
Security/signs	Inspection log	Quarterly	Annually			
Temperature and pressure monitoring systems	Inspection log	Quarterly	Annually			
Monitoring wells	Inspection log	Quarterly	Annually			
25-year, 24-hour storm event inspection	Inspection log	w/in 48-hours	w/ Annual	Same as quarterly	Same as quarterly	Section 10.7
Temperature monitoring under the cap	Data logger and printout	Continuously	Quarterly	Exceeds 22 degrees C	Notify EPA within 48 hours; monitor TMP for H_2, PH_3, HCN	Attachment 10-1; Section 1.5.2
Pressure monitoring under the cap	Data logger and printout	Continuously	Quarterly	Exceeds 27 inches Hg	Notify EPA within 48 hours; monitor for H_2, PH_3, HCN	Attachment 10-1; Section 1.5.3
			Notify within 48-hours	Pressure under cap exceeds 27 inches of mercury absolute pressure continuously for 1 week and gas concentrations are detected.	Install gas treatment system and convert pressure monitoring system to gas collection w/in 60 days	Attachment 10-1; Section 1.5.3
Cap drainage monitoring (not applicable Ponds 9E, 17 & 8E)	Inspection log	Annually	Annually	See Section 10.9 for decision tree	Evaluate/inspect/repair	Section 10.9
Topsoil monitoring (not applicable Ponds 9E, 17 & 8E)	Inspection log	Annually	Recorded only	5-inches below installed thickness at 50 percent of indicators	Add topsoil and revegetate	Section 10.10
Settlement monitoring						
During temporary fill/cap (not applicable Pond 9E)	Survey report	Monthly	Quarterly	Settlement less than 1-inch per year	Install final cap	
After final cap	Survey report	Annually	Annually	Exceeds acceptable rates	Engineering evaluation/repair	Section 10.4
Visible subsidence or local seismic event	Survey report	As soon as practical	Annually	Exceeds acceptable rates	Engineering evaluation/repair	Section 10.4
RCRA regulations/plant decommissioning	Post-closure Plan	60 days	60 days	Decommissioning activities or regulation changes	Revise the Post-closure Plan	Section 10

Note: * Unless greater or lesser frequency is approved by EPA.

A copy of this post-closure plan will be maintained at the FMC office at the site and will be made available to EPA upon request. The plan will be amended as necessary to accommodate any events or changes in decommissioning activities at the facility or changes in governing regulations that could impact the Phase IV ponds post-closure activities. Such an amendment (if necessary) will be submitted to EPA Region 10 at least 60 days prior to any proposed change in decommissioning activities or within 60 days after any unexpected event that affects the Phase IV ponds post-closure plan. After completion of post-closure care, FMC will certify completion of the post-closure activities as specified in 40 C.F.R. §265.120.

The Phase IV Ponds closure area is inside the fenced area of a plant. An FMC Contractor will provide adequate equipment and manpower to perform emergency repair work such as grading, replacement of soil, sandbagging, and placement of culverts or other drainage facilities, as needed, in the event of damages to the closure or drainage control systems.

10.1 POST-CLOSURE NOTICES

Within 60 days after certification of closure, FMC will file a survey plat and deed notice with the Power County recorder's office and provide a copy to the Regional Administrator as a record of the type, location, and quantity of waste placed in the pond as described in 40 C.F.R. §265.119(a).

Within the same time frame and in accordance with 40 C.F.R. §265.119(b), FMC will record an additional notation on the deed to the facility property that will in perpetuity notify any potential purchaser of the property that the land use is restricted under 40 C.F.R. Part 265, Subpart G regulations, and that a survey plat (as required under 40 C.F.R. §265.116) has been filed with the local authorities in accordance with 40 C.F.R. §265.119(b)(1)(iii). To protect the integrity of the cap and ongoing monitoring systems, land use restrictions will include prohibition of subsurface intrusion within the LFC and within 20 feet of the anchor trench. FMC will comply with all the post-closure notices required under 40 C.F.R. §265.119 briefly described above.

After completion of post-closure care, FMC will certify completion of the post-closure activities as specified in 40 C.F.R. §265.120

Several methods to provide longer-term markers to delineate the closed pond area were evaluated. After considering these methods, all were found to have limitations depending on the predicted future scenario. Aboveground structures such as walls or columns would interfere with maintenance activities (particularly emergency repairs to the cover system) and are not necessary until the RCRA pond closure process and CERCLA remedial action are completed for all the RCRA ponds at the site. FMC will continue to evaluate the need and nature of any long-term pond markers for the Phase IV Ponds.

10.2 SECURITY SYSTEM

The Phase IV ponds are wholly enclosed within the boundaries of the FMC Pocatello facility which itself has a combination of fencing, natural barriers and 24-hour surveillance to monitor and control entry. Access to the closed unit will be controlled to protect the cover, benchmarks, and monitoring systems from inadvertent access of unauthorized persons.

Signs will be posted at the entrance to the controlled closure area and in the vicinity of the Phase IV Ponds in sufficient numbers to be seen from any approach to the closed unit. The signs will be in English only, and will read 'Danger-Unauthorized Personnel Keep Out'. FMC will authorize specific personnel limited access to perform inspection, repair, maintenance, sample collection, and similar activities required for post-closure care.

10.3 INSPECTION

The closure area, including the final RCRA cap and monitoring equipment, will be inspected quarterly for the first five years and semiannually thereafter. The cap will be inspected within 48 hours after each 25-year, 24-hour storm event. Any degradation, erosion, slope failures, settlement, cracks, or damage will be recorded with related recommendations for repair or maintenance in the facility's operating record. All necessary repairs will be performed by FMC Contractors. Upon completion of repairs, a reinspection will be performed to document the date and acceptability of the repairs. A sample Inspection Record Form is provided in Figure 10-2. A final Facility Inspection Record Form for multiple regulated activities may be prepared and substituted for this form. This Facility Inspection Record Form will include all of the unit-specific information. Table 10-2 provides additional details on the types of inspections, the frequency and the maintenance action.

Documentation of all repairs or maintenance activities will also be maintained in the facility's operating record on site. All repairs to the final cover will be in accordance with the procedures as specified in the final cover construction specifications, including all testing and inspections as required by the final cover CQA plan (Appendix I of this Closure Plan).

Item/Condition Checklist	Inspection Results				Reinspection[2]		
	Date/ Time	Signature	Acceptable	Unacceptable[1]	Date/ Time	Signature	Acceptable
Monitoring Wells (groundwater, temperature, pressure) *- Barrier poles intact* *- Well covers intact and locked*							
Settlement Monitors *- Clear and accessible*							
Surveyed Benchmarks *- Clear and accessible*							
Vegetative Condition *- Grass living (root systems intact)* *- Uniform coverage (no bare spots)*							
Vegetative Soil Conditions *- Top soil indicators clear and accessible* *- No excessive erosion* *- No evidence of rodent or insect intrusion* *- No excessive ruts or potholes*							
Storm Water Management *- Swales clear of excess sediment/debris*							
Cap Drainage *- Subdrain outlet clear and accessible*							
Security Systems *- Fencing complete and intact* *- Signage intact*							
Slopes *- No sloughing or tension cracking* *- No excessive channels or washouts*							
Leachate Collection, Detection, and Removal System (if applicable) *- Manholes/covers intact* *- No excess liquid within sump*							
Others							

Notes:

(1) Explain the unacceptable conditions of each item; recommend any repairs (attach additional pages if necessary).

(2) Reinspect after satisfactory completion of any necessary repairs and note the acceptance of the repairs.

FIGURE 10-2 INSPECTION RECORD FORM

Table 10-2
Maintenance Activities

Inspection Item	Inspection Frequency	Maintenance Action	Cross Reference
Groundwater monitoring wells			
Field equipment	Quarterly	Repair or replace defective/damaged equipment	Attachment 10-1
Laboratory equipment	Quarterly	Recalibrate; repair or replace defective equipment	Laboratory QAPP; Attachment 10-1
Well covers	Quarterly	Replace damaged well covers	Section 10.3
Barrier poles	Quarterly	Repair or replace damaged barrier pole(s)	Section 10.3
Lock(s)	Quarterly	Replace missing or inoperable locks	Section 10.3
Cap and cover	Quarterly	Repair damage, replace topsoil, revegetate	Section 10.6
Monuments	Quarterly	Repair or replace damaged monument	Section 10.3
Drainage systems	Quarterly	Clear swales and ditches of sediment and debris	Section 10.7
Fencing	Quarterly	Repair fencing	Section 10.3
Signs	Quarterly	Replace signs	Section 10.3
Temperature monitoring			
Temperature monitoring well	Quarterly	Repair or replace damaged items	Section 10.3
Temperature sensors	Annually	Repair or replace sensor	Attachment 10-1
Temperature alarm and light	Quarterly	Replace alarm and/or light	Attachment 10-1
Digital indicators and recorders	Quarterly	Replace digital indicators	Section 10.8
Hand-held download terminal	Quarterly	Replace hand-held terminal	Section 10.8
Pressure monitoring			
Pressure data logger	Quarterly	Repair or replace data logger	Attachment 10-1
Alarm panel	Quarterly	Repair alarm panel	Attachment 10-1
Pressure sensor	Annually	Repair or replace sensor	Attachment 10-1
Temperature alarm and light	Quarterly	Replace alarm and/or light	Attachment 10-2b
Portable computer	Quarterly	Repair or replace portable computer	Attachment 10-2b
Gas sampling			
Valve, tubing, ferrule	Quarterly	Replace damaged or missing equipment	Attachment 10-1
Portable gas detectors (H_2, PH_3, HCN)	Annually	Repair or replace gas detector(s)	Attachment 10-1

10.4 FINAL COVER SETTLEMENT MONITORING

To monitor final cover settlement, the elevation and coordinates of each displacement monument will be surveyed to determine the vertical and horizontal components of the final cover monuments. Measurements will be taken on the monuments at least monthly during the first year, and annually thereafter. For accuracy, a surveying instrument will be used to take measurements with the following tolerances:

- Elevation readings 0.01 foot
- Horizontal displacement 0.1 foot

Elevation and displacement measurements will be plotted cumulatively versus time. The time scale will be in logarithm of time or square root of time. The settlement curve will be kept up to date with each reading.

The displacement measurements (vertical and horizontal movements) will be made annually during the remaining post-closure period or until the total cumulative movements for the last five years are less than the following limits:

- Vertical settlement 0.03 foot
- Horizontal movement 0.2 foot

Displacement measurements will be made (1) at least once every five years during the post-closure period after these limits are reached; (2) if marked, visible subsidence is noted during semiannual inspections or routine maintenance; and (3) after local seismic events.

Settlement monitoring will be based on control stations "94-1" and "94-4," which are local stations in FMC's survey control system. The coordinates for these stations were derived from the US Coast & Geodetic Survey (US C&GS) Control Station MCDOUGAL-2 and BM Y-96. The vertical datum is based on the 1968 adjustment of the National Geodetic Vertical Datum of 1929 (NGVD 29) by the U.S. Coast & Geodetic Survey.

Any damaged monument detected during post-closure inspections either will be repaired or replaced in accordance with the construction drawings and specifications used during closure (see Appendix I of this Closure Plan).

10.5 GROUNDWATER MONITORING

Groundwater from designated RCRA monitoring wells upgradient and downgradient of the Phase IV ponds will be sampled and analyzed to provide data regarding groundwater quality beneath and in the vicinity of the unit during the post-closure period. Groundwater monitoring with respect to the Phase IV ponds will be conducted in accordance with FMC's RCRA Interim Status Groundwater Monitoring Plan, August 1999 until superseded by an EPA approved post-closure plan or permits. The Sampling and Analysis Plan for post-closure groundwater monitoring is contained in Attachment 10 of this section. The one upgradient and four downgradient groundwater monitoring wells will be sampled for the following parameters:

- Heavy metals – arsenic, cadmium, and selenium.
- Water quality – ammonia, chloride, fluoride, potassium, nitrate, sulfate, and orthophosphate.
- Field parameters – pH, turbidity, temperature, water level, and specific conductance.

The groundwater monitoring program will continue throughout the entire post-closure period of 30 years, unless shortened or lengthened by the Regional Administrator in accordance with 40 C.F.R. §265.117.

10.6 CAP MAINTENANCE

The vegetative cover will be maintained regularly, as necessary, to preserve or assure adequate grass coverage. Eroded soils and vegetation will be replaced. Surface slopes will be maintained to prevent any localized ponding. Cracks will be filled with topsoil and seeded. If regular inspections detect vector activity, such as fresh soil piles or holes, the damage will be repaired and traps set for rodent control. If settlement in excess of 1 inch is observed in 1 year or possible damage to the geosynthetic clay barrier is suspected, a registered Professional Engineer will be consulted to assess potential damage and recommend any necessary repairs. An FMC Contractor will perform the repairs as part of the scheduled maintenance program. Table 10-2 provides additional details on the types of inspections, the frequency, and the maintenance action.

10.7 STORM WATER MANAGEMENT

The Phase IV ponds storm water management system will be inspected and repaired semiannually and within 48 hours after each 25-year, 24-hour storm event. Sediment and trash accumulations in drainage swales will be removed to facilitate proper drainage. Eroded swales will be repaired.

10.8 PRESSURE AND TEMPERATURE MONITORING

To ensure the detection of reactions within the waste that could impair cap integrity, a monitoring system designed to monitor temperature and pressure will be operated.

The temperature monitoring will be in the sand layer above the waste and underneath the slag layer. The system is designed to provide early warning of temperature rises in the waste which may be indicative of a reaction. The temperature monitoring system will consist of 13 probes (four each in Ponds 11S, 12S, and 13S, one in 14S) installed in monitoring wells in the ponds. Temperature will be continuously recorded by RTD sensors inside each monitoring well.

The pressure underneath the final cover will be monitored by a system equipped with absolute pressure sensors. Absolute pressure underneath the final cover will be continuously recorded.

Regular temperature and pressure monitoring, as well as additional monitoring as triggered by preset levels and alarms, will be conducted in accordance with the RCRA Temperature, Pressure, and Gas Monitoring FSP contained in Attachment 10-2b. The alarm panel is included in the Local Monitoring Panel and is shown on Drawing 270-C-213. A description of the soil gas monitoring system is located in Attachment 10-1, Section 2.4.2.3 and Attachment 10-2b, Section 4.4. The operations and maintenance of the monitoring systems are discussed in Attachment 10-1, Section 2.6.2 and Attachment 10-2b, Section 4.

The pressure data will be collected and reviewed and if the trend shows the pressure is continuously on the increase, FMC will initiate the gas treatment system detail design and the preparation of the system's procurement documents. If the pressure under the cap exceeds 27 inched of mercury absolute pressure, then an alarm will be sounded. Upon confirmation that the gas pressure exceeds 27 inches of mercury, soil gas sampling will be conducted.

If gas samples from the temperature monitoring wells indicate detectable concentrations of phosphine or hydrogen gas and the pressure remains over 27 inches of mercury absolute continuously for a one week period, FMC will procure and install the treatment system and convert the pressure monitoring system to a gas collection and treatment system in accordance with Section 7.1.4.2 "Treatment of Phosphine Gas" of the Closure Plan.

Quarterly temperature and pressure monitoring will continue until such a time as a demonstration can be made for reduced frequency or parameters. In this event, FMC will request EPA approval to reduce the post-closure monitoring period in accordance with 40 C.F.R. 265.118(g).

The signals from the pressure and temperature sensors will be continuously transmitted to digital indicators and recorders. A handheld terminal will be provided to download each transmitter record for data logging. All data will be collected and reviewed at least quarterly.

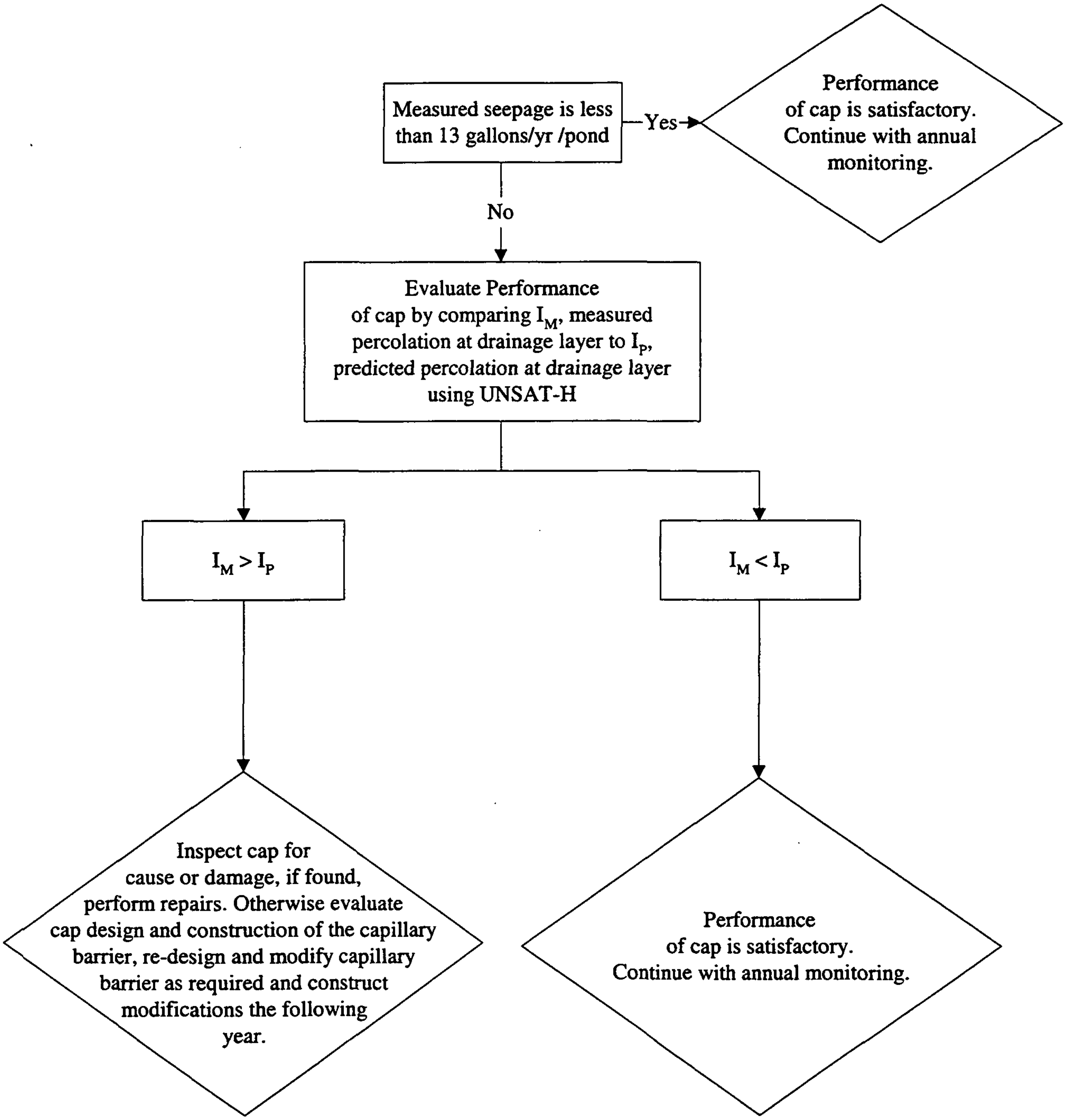
If the temperature and pressure are above the triggers (22°C or 27 inches of mercury), then FMC will notify EPA, Region 10. Notifications will be made within 48 hours or the morning of the next business day. Also, if the absolute pressure remains continuously above 27 inches of mercury for a one-week period and PH_3 or HCN are detected, then FMC will notify EPA within 48-hours and proceed to procure and install a gas treatment system and convert the pressure monitoring system to a gas collection and treatment system. A catalytic adsorptive carbon treatment system would be installed within 60 days, excluding permitting. A discussion of the gas collection and treatment system and schedule is presented in Section 7.1.4

10.9 CAP DRAINAGE MONITORING

Volumes of seepage, measured at the subdrain outlets of the Phase IV ponds closure cap drainage layers, will be collected annually. Flow volume measurements from the drainage layer will be compared with predicted infiltration and actual precipitation to evaluate the performance of the cap.

The steps that will be followed to evaluate the performance of the cap are shown in Figure 10-3, and as described below:

I. The measured annual seepage rate, which represents the percolation at the drainage layer at the bottom of the capillary barrier, will be compared to the minimum annual percolation of 10^{-4} in/yr (13 gallons/yr for each individual Phase IV pond's total cap area), predicted by the UNSAT-H model for the simulated 600 year period (see Appendix H, Figure H-2):



I_M: Measured percolation at drainage layer

I_P: Predicted percolation at drainage layer using UNSAT-H

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO, LLC POCATELLO, IDAHO			
Drainage Monitoring Plan			
	Job No.	Drawing No.	Rev.
	24230	Figure 10-3	2

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II. If the measured seepage rate is less than the minimum annual percolation rate, the performance of the cap will be deemed satisfactory. Annual drainage monitoring will continue.

III. If the measured seepage rate exceeds the minimum annual percolation rate, infiltration through the capillary barrier will be reevaluated based on the recorded daily rainfall and temperature data for that year using the UNSAT-H model.

IV. If the measured seepage rate exceeds the revised infiltration rate, FMC will inspect the cap for specific cause or damage. If the cause or damage is found, the cap will be repaired, otherwise the cap design and construction will be re-evaluated and the capillary barrier portion of the cap will be re-designed and modified as required to ensure the performance of the Phase IV ponds final cap meets the performance standards of the Closure Plan. The required modifications of the capillary barrier will be constructed during the next construction season, while taking care not to damage the underlying low-permeability composite cap layer.

Cap drainage monitoring will continue until such a time as a demonstration can be made for reduced frequency. In this event, FMC will request EPA approval to reduce the post-closure monitoring period in accordance with 40 C.F.R. 265.118(g).

10.10 CAP EROSION MONITORING

The nineteen topsoil indicators will be inspected and recorded annually to monitor cap erosion. When topsoil (loss) measurement reaches 5 inches below the installed thickness at 50-percent of the indicators, the total cap area will be evaluated. Depending on the actual observed erosion rate compared to the calculated rate, topsoil will be added as necessary and revegetated. This monitoring, in combination with routine post-closure inspection and maintenance activities as described in Subsection 10.6 will ensure that the topsoil layer continues to meet the design requirement. The detailed plans and specifications (including the number and location of topsoil thickness indicators) will be prepared after settlement of the initial fill reaches the design acceptable rate.

10.11 RECORDKEEPING AND REPORTING

Closure and Post-closure Plans, including cost estimates, monitoring data, inspection records, and certifications are part of the facility operating record. The operating record is located in the facility's files at the site. Except for inspection records, which must be kept for 3 years, the information contained in the operating record will be maintained at the facility until closure and/or post-closure (in the case of groundwater monitoring information) have been completed. In addition, as required by the Consent Decree (CD), records required by the CD will be retained for a minimum of three years after termination of the CD and all documentation prepared in connection with each report shall be maintained until one year following EPA's written approval of each report.

FMC will report to EPA, as required by this closure and post-closure plan or applicable law, any environmental releases, spills, groundwater monitoring data, emergency incidents, wildlife mortality, or other situations potentially threatening to human health or the environment.

Attachment 10

RCRA SAMPLING AND ANALYSIS PLANS

Attachment 10-1

FMC RCRA Quality Assurance Project Plan
Pocatello Elemental Phosphorus Plant

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FMC RCRA Quality Assurance Project Plan
Pocatello Elemental Phosphorus Plant

1. PROJECT MANAGEMENT

This plan describes the quality assurance and quality control (QA/QC) requirements for sampling and analyses activities performed at the FMC Idaho, LLC (FMC) formerly Astaris Idaho, LLC (Astaris) Pocatello Elemental Phosphorus Plant to meet the Resource Conservation and Recovery Act (RCRA) requirements for interim status specified in 40 CFR 265. This facility ceased producing elemental phosphorus from phosphate ore in December 2001 and is no longer in operation. This plan was prepared following the guidelines for QA Project Plans in EPA SW-846 (EPA 1997), Guidance for the Data Quality Objectives (DQO) Process (EPA 2000), EPA Requirements for Quality Assurance Project Plans (EPA 2001), and pursuant to applicable 40 CFR 264 Subpart F criteria and objectives. This Quality Assurance Project Plan (QAPjP) will be revised when appropriate, per 40 CFR §270.42. The requirements of this QAPjP are implemented using field sampling plans (FSPs) that provide detailed field procedures for sampling and analyses.

This QAPjP and the associated FSPs constitute a RCRA sampling and analysis plan used for environmental data collection associated with waste management units (WMUs) at the Pocatello Elemental Phosphorus Plant. Environmental data collection includes groundwater monitoring to determine if WMUs are impacting the uppermost aquifer and pressure, temperature and gas monitoring to determine if exothermic reactions and/or gas generation beneath the closure cover systems are occurring at RCRA capped WMUs.

This document is organized as follows: Section 1 - Project Management addresses project management, including the project history and objectives and roles and responsibilities of the participants; Section 2 - Data Generation and Acquisition addresses all aspects of project design and implementation, which ensures that appropriate methods for sampling, measurement and analysis, data collection or generation, data handling and quality control (QC) activities are employed and properly documented; Section 3 - Assessments and Oversight addresses the requirements for assessing the effectiveness of the QC measures described in this QAPjP; and Section 4 - Data Validation and Usability provides requirements for data validation and assurance of data usability.

1.1 Project Organization

The project organization is shown in Figure 1. The responsibilities of key project personnel are as follows:

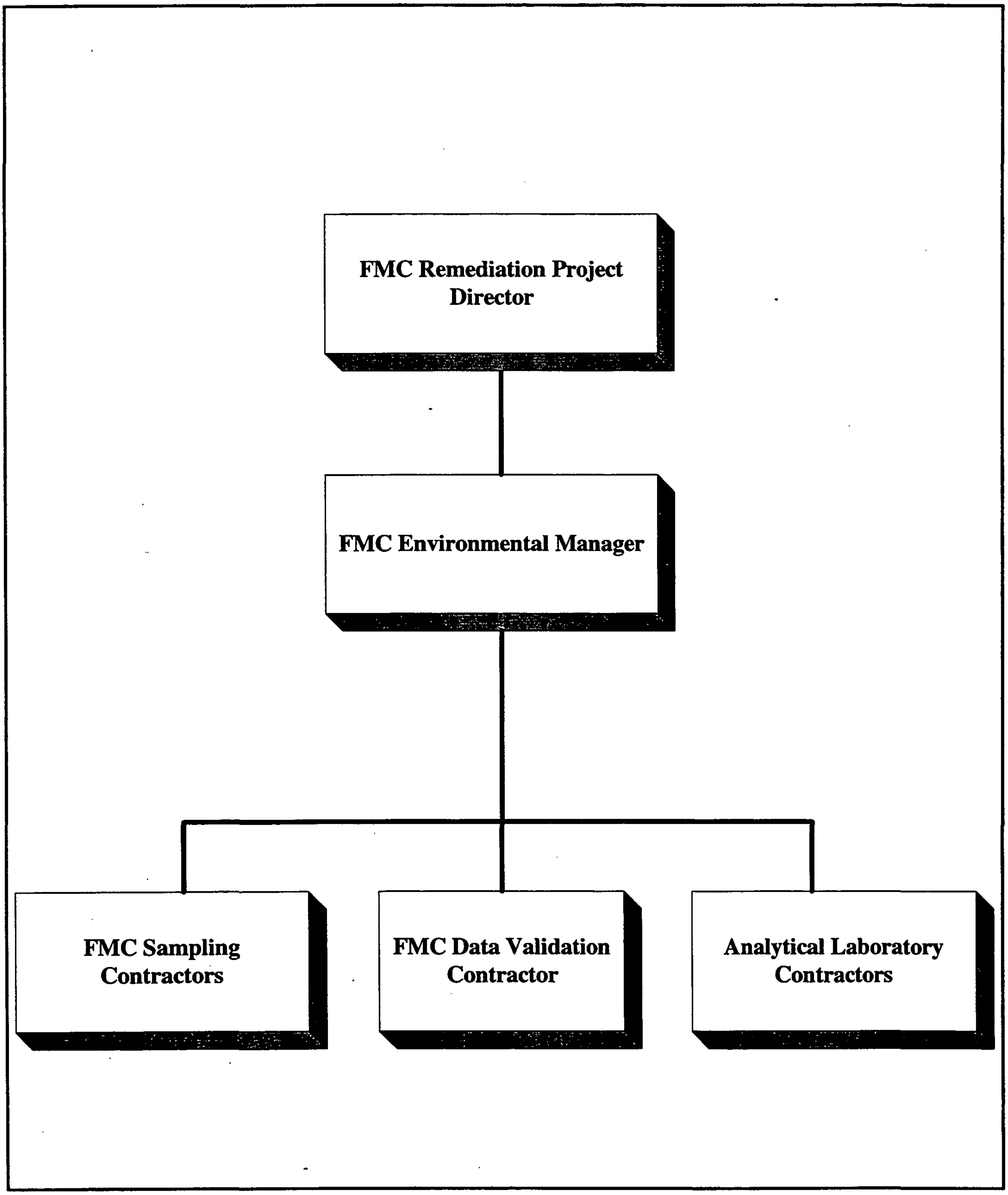

FIGURE 1
PROJECT ORGANIZATION

- FMC Remediation Project Director - overall project responsibility.
- FMC Environmental Manager - responsible for managing specific field activities (e.g. groundwater monitoring/cap monitoring/confirmatory soil sampling) including direct management of field supervisors and subcontractors. Also responsible for assembly, organization and maintenance of all information collected during monitoring activities.
- FMC Groundwater Sampling Contractor - responsible for the representativeness of samples collected and reporting of field data relevant to groundwater monitoring and data management. Also responsible for maintenance of groundwater monitoring database.
- FMC Analytical Laboratory Contractor QA Officer - responsible for the accuracy and precision of data resulting from analysis of groundwater monitoring samples.
- FMC Data Validation Contractor - responsible for validation of groundwater data.

All personnel are responsible for identifying problems that may arise in the collection and reporting of project data and overseeing the implementation of the necessary corrective actions.

- The FMC Environmental Manager will track, review, and verify the effectiveness of corrective actions.

1.2 Background

The FMC Pocatello Plant was in continuous operation from 1949 through 2001. The facility ceased producing elemental phosphorus from phosphate ore in December 2001. RCRA groundwater monitoring has been conducted at the facility since 1990, when the plant became subject to RCRA Subtitle C permitting and groundwater monitoring standards. Waste Management Units (WMUs) at the plant are in various stages of closure and post-closure. Some WMUs have been closed as a hazardous waste management landfill which includes placing a final RCRA cap over the unit. The plant is a RCRA treatment, storage, and disposal facility (EPA Identification Number IDD 070929518).

1.3 Project Description

This section identifies and provides a schedule and specifies the nature of monitoring at each of the FMC WMUs subject to RCRA groundwater monitoring and cap monitoring requirements. Each WMU and associated RCRA groundwater monitoring wells and RCRA cap monitoring locations are identified in figures and Appendices in the FSPs. Table 1 identifies the upgradient and downgradient monitoring wells for each WMU. Table 2 identifies the pressure, temperature, and gas monitoring points for RCRA caps.

TheWMUs at the plant are subject to closure in accordance with 40 CFR Part 265 and are in various phases of the RCRA closure process.

1.3.1 Project Schedule

RCRA interim status groundwater monitoring, pursuant to 40 CFR. Part 265, Subpart F, has been ongoing on a quarterly basis since 1991. The results of the assessment program are reported in annual groundwater assessment reports.

For WMUs closed with waste in place, temperature and pressure are continually monitored after installation of the RCRA cap to evaluate potential reaction(s) and/or gas generation beneath the final cover system.

TABLE 1
WMU-SPECIFIC RCRA GROUNDWATER MONITORING WELLS

		Monitoring Well I.D. Numbers	
WMU No.	***WMU Name***	***Upgradient***	***Downgradient***
3	*Phossy Waste Surface Impoundment (Pond 15S)*	*165*	*113, 115 and 166*
5	*Slag Pit Sump*	*121*	*108, 122, and 123*
7	*Phossy Waste Surface Impoundment (Pond 8S)*	*158, 183*	*155, 156, and 157*
8	*Phossy Water Clarifier Surface Impoundments (11S, 12S, 13S, and 14S) -- Phase IV Ponds*	*167*	*104, 114, 131, and 168*
9	*Precipitator Slurry Drying Surface Impoundment (Pond 9E)*	*124, 113*	*126, 127, and 128*
10	*Phossy Waste Surface Impoundment (Pond 16S)*	*154*	*147, 148, and 149*
11	*Precipitator Slurry Surface Impoundment (Pond 8E)*	*167*	*104, 114, 131, and 168*
14	*Pond 17*	*173*	*171, 172, 180*
15	*Pond 18*	*174, 175*	*154, 176, 177, 178*
	Pond 18, Cell A	*174*	*154, 177, 178*

TABLE 2
WMU-SPECIFIC RCRA CAP MONITORING POINTS

		CAP Monitoring I.D. Numbers		
WMU No.	***WMU Name***	***Temperature***	***Pressure***	***Gas Monitoring***
3	*Phossy Waste Surface Impoundment (Pond 15S)*	*T01 to T010*	*Pressure Monitoring Station P01*	*NA*
7	*Phossy Waste Surface Impoundment (Pond 8S)*	*T01 to T04*	*Pressure Monitoring Station P01*	*GM-1 through GM-10* *(around perimeter at toe of the final cap)*
8	*Phossy Water Clarifier Surface Impoundments (11S, 12S, 13S, and 14S) -- Phase IV Ponds*	*T01 to* *T013*	*Pressure Monitoring Stations P01 to P04*	*NA*
9	*Precipitator Slurry Drying Surface Impoundment (Pond 9E)*	*T01 to T010*	*Pressure Monitoring Station P01*	*NA*
10	*Phossy Waste Surface Impoundment (Pond 16S)*	*T01 to T08*	*Pressure Monitoring Station P01*	*NA*
11	*Precipitator Slurry Surface Impoundment (Pond 8E)*	*T01 to T04*	*Pressure Monitoring Station P01*	*NA*
14	*Pond 17*	*T01 to T06*	*Pressure Monitoring Station P01*	*NA*
15	*Pond 18*	*NA*	*NA*	*NA*
	Pond 18, Cell A	*T01 to T04*	*Pressure Monitoring Station P01*	*NA*

1.4 Problem Definition

This section discusses the objectives for which environmental data are needed. The EPA seven step process (EPA 2000) was used to develop the sample and analysis requirements specified in this QAPjP and FSPs. The key elements of the steps used in this QAPjP are embedded using text boxes in this document.

DQO STEP 1: STATE THE PROBLEM

Comprehensive scoping effort:

WMU-specific Closure Plans (FMC 1998a, FMC1998b, FMC 1998c, FMC 1998d, FMC 2000, Astaris 2001a, Astaris 2001b, and Astaris 2001c) provide historical information.

Conceptual Site Model:

Various project documents including remedial investigation reports, closure plans, and annual groundwater assessment reports discuss the conceptual site model.

Objectives Statement:

Environmental data are needed to meet the following objectives:

1. *In order to show that a WMU has not affected the groundwater quality, the concentration or value of selected groundwater parameters in the uppermost aquifer beneath the WMU will be measured.*
2. *Temperature and pressure and, if applicable, soil-gas under the closure cap will be measured as indicators of chemical reactions that may be occuring within specific RCRA WMU(s).*

DQO STEP 2: IDENTIFY THE DECISION

1. *Determine whether the concentration or value of selected parameters in the groundwater monitoring data at a WMU indicate a release of a waste constituent into the groundwater requiring further evaluation and potential notification to EPA Region 10 or continue quarterly sampling as planned for the WMU.*

2a. *Determine whether the temperature and pressure measurements indicate the occurrance of chemical reactions in the waste and require sampling/measurement of the gas and require notification of EPA Region 10 or that require no action.*

2b. *Determine whether the pressure within the RCRA closure cap indicate the generation of gas, require the collection and treatment of the gas and require notification to EPA Region 10 or continue monitoring per Decision Statement 2a.*

1.5 Quality Objective and Criteria

The overall objective of the groundwater monitoring program is to collect samples representative of the groundwater flowing beneath each WMU to verify the WMU is not impacting the uppermost aquifer.

The overall objective of the cap monitoring program is to determine if chemical reactions are occurring under the closure cap (through temperature and pressure measurements), because such reactions may compromise the integrity of the closure cap. Also, the potential exists for the generation of gases in quantities/concentrations that could be hazardous to human health and environment.

To meet these objectives, data of known quality will be collected and analyzed. To facilitate the required statistical analyses, discussed below, analytical methods with the lowest routinely achievable detection limits will be used. This will assure that the required statistical analyses are performed using as many values above the minimum detectable level as possible.

1.5.1 Groundwater Assessment Monitoring

The objective of groundwater assessment monitoring is to collect groundwater data to monitor the potential impact of WMUs on the underlying uppermost aquifer. To meet this objective, samples from groundwater wells associated with each WMU are collected and analyzed for the parameters specified in Table 3. These parameters are based on facility operations, previous site investigations, historical RCRA groundwater assessment monitoring program results, and the requirements for groundwater monitoring specified in 40 CFR 265, Subpart F. In June 1995, the RCRA groundwater assessment monitoring program was reduced from a list of 37 inorganic parameters and four radiological parameters to 10 inorganic parameters (EPA 1995) which are listed in Table 3. Results from analysis of samples collected from downgradient detection monitoring wells at each WMU will be compared to results from analysis of samples collected from the associated upgradient well(s) to determine if there is statistically significant evidence of a release.

1.5.2 Cap Temperature Monitoring

To detect a temperature increase that may indicate an exothermic reaction is occurring in the waste, a temperature monitoring system will be installed in the sand layer above the waste (see details in Cap Monitoring Field Sampling Plan, Figure 1). Temperature will be continuously recorded. If the measured temperature in one or more of the temperature monitoring locations exceeds 22 degrees C, the alarm will sound by signal from the temperature data logger, the FMC Environmental Manager will be immediately notified, and gas in the temperature monitoring wells will be monitored to determine if hydrogen and phosphine are present. If phosphine is detected, hydrogen cyanide will be monitored.

1.5.3 Cap Pressure Monitoring

To detect a pressure increase that may indicate potential gas generation in the buried waste, a pressure monitoring system will be installed. This monitoring system will consist of a gas collection pipe installed around the periphery and a pipe(s) along the longest dimension and through the center of the pond. This gas collection pipe will be beneath the final cap (see details in Cap Monitoring Field Sampling Plan, Appendix A). The absolute pressure within this gas collection system will be continuously recorded. The pressure alarm will light if at any time the pressure in the pipe is 27 inches of mercury absolute pressure (equivalent to a pressure of approximately 31.9 inches of mercury at mean sea level) and the FMC Environmental Manager will be notified immediately. Then the gas within the temperature monitoring wells will be analyzed to determine if hydrogen and phosphine are present. If phosphine is detected, hydrogen cyanide will be monitored.

The pressure and temperature monitoring system for a typical RCRA Cap is shown in the Field Sampling Plan for RCRA Cap Monitoring.

DQO STEP 3: IDENTIFY THE INPUTS TO THE DECISIONS

The informational inputs required to address the Decision Statements are reported in Tables 3 and 4. They include: Constituents/Parameters of Concern (COCs), Analytical Methods, Detection Limits, Data Quality Indicators.

DQO STEP 4: SPECIFY THE BOUNDARIES

<u>Population of Interest:</u>

Groundwater: WMU and underlying uppermost groundwater aquifer beneath each WMU.

RCRA Cap: In-place waste within each WMU

<u>Spatial Boundaries:</u>

The geographical boundaries of the in-place waste in each WMU.

<u>Temporal Boundaries:</u>

RCRA regulations require groundwater monitoring to be performed on a quarterly basis. The quarterly sample events are reported in an annual groundwater assessment report. The groundwater monitoring program will continue throughout the post-closure period of 30 years.

Irrespective of the potential seasonal effects on the measurements of the temperature and pressure data, it will be logged continuously and reviewed quarterly.

DQO STEP 5: DEFINE DECISION RULES

Decision Rule 1a: If the concentration a groundwater indicator parameter indicates a statistically significant increase from the previous years monitoring data for a WMU, then further evaluation is necessary to determine if a release at the WMU has occurred. Proceed to Decision Rule 1b.

Decision Rule 1b: The concentration of arsenic (As), fluoride (F^-), or selenium (Se) as indicator constituents will be evaluated to determine if a statistically significant release has occurred from a WMU using the following statistical tests:

Test 1: Concentrations of indicator constituents (As, F^- and Se) in the downgradient wells are statistically higher than the corresponding concentrations in the upgradient wells as computed using the Mann-Whitney U-test, and

Test 2: Mean concentration of the indicator constituents (As, F^- and Se) for the current year is higher than the previous years' corresponding mean concentrations or is inconclusive as computed using software integrated into Microsoft Excel, and

Test 3: Concentrations of indicator constituents (As, F^- and Se) in all the downgradient wells are statistically increasing with time as computed using the Mann-Whitney U-test; then, evaluation of a release from the WMU will be considered and the EPA will be notified, otherwise continue quarterly groundwater monitoring as planned for the WMU.

Decision Rule 2a: If the temperature under the cap measured by one or more of the temperature monitors is greater than 22 °C or the pressure under the cap measured by the pressure monitor is greater than 27 inches of mercury (absolute), then an exothemic reaction with the potential of generating gases may be occurring and requires sampling/ measurement and the notification of EPA Region 10.

Decision Rule 2b: If the pressure under the cap measured by the pressure monitor is greater than 27 inches of mercury (absolute) for 7 days and PH_3 or HCN gases are detected then the WMU requires the installation of a gas collection and treatment system and the notification of EPA Region 10.

TABLE 3

SUMMARY OF REQUIRED ANALYSES FOR RCRA GROUNDWATER ASSESSMENT MONITORING

Analytical Parameter	Analytical Method Number	Analytical Method Type	Method Detection Limit (ppm)	Accuracy	Precision	Comment
Laboratory Analytical Parameters						
Ammonia	350.3	Potentiometric, Ion Selective Electrode	0.2	70% - 130%	± 35%	May be useful for assessing changes in groundwater quality.
Chloride	325.3	Titrimetric (mercuric nitrate)	all ranges	70% - 130%	± 35%	Indicator parameter for leak detection. Groundwater quality parameter.
Fluoride	340.2	Potentiometric, Ion Selective Electrode	0.1	70% - 130%	± 35%	Waste constituent and indicator parameter for leak detection
Nitrate	353.2	Colorimetric (brucine sulfate)	0.1	70% - 130%	± 35%	Useful for assessing changes in groundwater quality
Orthophosphate	365.2	Colorimetric (ascorbic acid)	0.1	70% - 130%	± 35%	Waste constituent useful for assessing changes in groundwater quality.
Phosphorus (P_4)[1]	7580	Gas Chromatography/ Mass Spectrometry	0.00005	70% - 130%	± 35%	Waste constituent. Compliance monitoring Pond 8S and Slag Pit Sump only
Sulfate	375.4	Gravimetric	5	70% - 130%	± 35%	Waste constituent and indicator parameter for leak detection. Groundwater quality parameter.
Total Phosphorus	365.4	Colorimetric	0.1	70% - 130%	± 35%	Compliance monitoring. Slag Pit Sump only
Arsenic	6010B	Inductively Coupled Plasma Atomic Spectroscopy	0.005	70% - 130%	± 35%	Waste constituent detected in groundwater. Parameter to evlaluate suitability of groundwater as a drinking water supply.
Cadmium			0.005	70% - 130%	± 35%	Waste constituent of concern. Parameter to evlaluate suitability of groundwater as a drinking water supply.
Potassium			5	70% - 130%	± 35%	Indicator parameter for leak detection
Selenium			0.005	70% - 130%	± 35%	Waste constituent detected in groundwater. Parameter to evlaluate suitability of groundwater as a drinking water supply.

TABLE 3 (CONTINUED)

SUMMARY OF REQUIRED ANALYSES FOR RCRA GROUNDWATER ASSESSMENT MONITORING

Field Analytical Parameters – Groundwater Monitoring						
pH	Manufacturer's Instructions	pH meter	N/A	± 0.5 pH units	0.1 pH unit	Required field parameter. Water quality indicator parameter.
Nephelometric turbidity (NTU)	Manufacturer's Instructions	Turbidity meter	0.1-1 NTU	N/A	± 1% full scale or 0.05% of measurement in NTU	Required field parameter
Specific conductance	Manufacturer's Instructions	Conductivity meter	N/A	N/A	± 1%	Required field parameter. Water quality indicator parameter.
Temperature	Manufacturer's Instructions	Temperature meter	N/A	N/A	0.5 °C	Required field parameter.
Groundwater surface elevation	Manufacturer's Instructions	Electrical water probe Steel tape	N/A	N/A	0.05 ft 0.01 ft	Required field parameter per 40 CFR 265.92(e).

[1] ***Semi-annual analysis required for WMUs as specified in FSP.***

N/A ***Not applicable.***

TABLE 4

SUMMARY OF REQUIRED ANALYSES FOR RCRA CAP MONITORING

Analytical Parameter	Analytical Method	Action Level	Precision/Criteria	Comment
Field Parameters – Temperature, Pressure, and Gas Monitoring				
Temperature	Manufacturer's Instructions on Resistance Temperature Detector	22° C	± 0.5° C	Detect exothermic reaction in the buried waste
Pressure	Manufacturer's Instructions on Absolute Pressure Sensor	27 in. Hg abs.	Resolution equal to 1.5 kPa = 0.443 in. Hg.	Detect exothermic reaction in the buried waste
Hydrogen gas	Manufacturer's Instructions on Electrochemical, gas selective detector (ATI B16-18-1-1000-1 or equivalent)	Detectable quantity	Detectable limit = 30 ppm	Measured only if Action Level for Temperature and Pressure is exceeded.
Phosphine gas	Manurfacturer's Instructions on Electrochemical, gas selective detector (ATI B16-32-1-1000-2 or equivalent)	Detectable quantity	Detectable limit = 10 ppb	Measured only if Action Level for Temperature and Pressure is exceeded.
Hydrogen cyanide gas	Manufacturer's Instructions on Electrochemical, gas selective detector (ATI B16-22-1-0020-2 or equivalent)	Detectable quantity	Detectable limit = 20 ppb	Measured only if Hydrogen gas and Phosphine gas are detected.

1.6 Special Training Requirements/Certification

All personnel directly involved in sample collection, handling, analysis, and data evaluation will be provided with a copy of this QAPjP and the applicable FSPs. Personnel will be trained in the requirements specified herein, or provided ample time to read and become familiar with the requirements prior to beginning data collection activities.

1.7 Documentation and Records

Records of the analyses and evaluations required by this plan will be maintained by FMC at the Pocatello plant throughout the post-closure care period. Laboratory documentation and records requirements are specified in the laboratory QAPjP. Required field documentation is specified in the companion Field Sampling Plan.

2. DATA GENERATION AND ACQUISITION

This section provides requirements for sampling program design, sample collection, handling, analysis, and data management. These requirements ensure that appropriate methods for sampling, analysis, data handling, and quality control are employed and documented.

2.1 Sampling Process Design

DQO STEP 6: SPECIFY ERROR TOLERANCES

Groundwater Assessment Monitoring

The indicator constituent (As, F^-, Se) concentrations will be within 95% Upper Confidence Limit of the mean. In the statistical analyses the Mann-Whitney U-test is used at the level of significance of $\alpha=0.05$ or 95% confidence (i.e., if the test yielded a ρ-value of less than 0.05, the null hypothesis is rejected and the two medians are considered statistically different).

The pH meter, water level meter, and water temperature measurements are ± 0.1 pH units, ± 0.01 ft, and ± 0.5 °C respectively of actual value. The specific conductance and turbidity measurements will be within ± 1% and, and ± 1% of the full scale, respectively of actual value.

RCRA Cap Monitoring

The temperature and pressure measurements will be within ± 0.5 °C and ± 0.443 in. Hg, respectively of actual value.

The detection limits of the phosphine gas (10 ppb) and hydrogen cyanide gas (20 ppb) are well below their respective National Institute for Occupational Safety and Health (NIOSH) standards of 300 ppb and 4,700 ppb. There are no published values for NIOSH standards for hydrogen gas.

DQO STEP 7: SAMPLE DESIGN

Groundwater Assessment Monitoring

The groundwater monitoring system wells are sampled and analyzed to satisfy the requirements of 40 CFR 265, Subpart F. The sampling frequency and parameters of concern have developed over the history of the monitoring program and are documented in RCRA Interim Status Groundwater Monitoring Assessment Reports. WMU wells identified in Table 1 are sampled on a quarterly basis for the Table 3 parameters of concern.

RCRA Cap Monitoring

The WMU-specific sampling design for the temperature, pressure, and gas monitoring is described in Section 7 of the WMU-specific Closure Plan.

2.2 Sampling Methods

The groundwater monitoring wells associated with each WMU will be sampled in accordance with the detailed procedures presented in the RCRA Groundwater Monitoring FSP.

Temperature and pressure will be monitored in situ, and soil-gas samples will be collected, as determined by the temperature and pressure readings. It is important that the monitoring locations be situated in a manner that assures the temperature and pressure are representative of the environment beneath and along the edge of the WMU. The measures to assure this representativeness are described in detail in the FSP for RCRA Cap Monitoring.

2.3 Sample Handling and Custody

The groundwater samples will be handled and custody will be maintained in accordance with the detailed procedures presented in Section 6 of the RCRA Groundwater Monitoring FSP. Soil-gas will be sampled according to the monitoring procedures specified in Section 4.4 of the RCRA Cap Monitoring FSP. Soil gas samples do not require handling and custody.

2.4 Analytical Methods

2.4.1 Analysis of Groundwater Samples

The analytical methods that will be used on groundwater monitoring samples are summarized in Table 3. The table specifies method number, method type, and method detection limit ranges. Method detection limits presented on Table 3 for each analysis represent the best reporting limits that can be attained by the specified methodology. Data from multiple dilutions will be used, as necessary, to quantify target components within the calibrated range. Actual detection limits obtained during analysis will be reported by the laboratory for each parameter in each sample.

The laboratory performing the analyses will have an established quality assurance/quality control (QA/QC) plan and all analyses will be performed in accordance standard operating procedures consistent with the QA/QC plan. Where analytical or QA/QC procedures presented in the QAPjP are different from those presented in the laboratory QA/QC plan, procedures presented in this QAPjP will govern.

2.4.2 Temperature and Pressure Measurements, Soil-gas Detection and Sampling

A resistance temperature detector, a diaphragm pressure sensor, and portable gas detectors (specific to each gas – H_2, PH_3, and HCN) will be used to monitor temperature and pressure and to sample soil gas, respectively.

2.4.2.1 Temperature Measurement

Temperature in the temperature monitoring wells will be measured and recorded continuously using a four wire resistance temperature detector. Resistance changes in the platinum tip of this sensor will be transmitted to a data logger as a 4 to 20 mA signal corresponding to a temperature range of 0 to 35 degrees C.

2.4.2.2 Pressure Measurement

Absolute pressure in the gas collection pipe will be measured continuously using a diaphragm pressure sensor. The sensor capacitance is proportional to pressure and will be transmitted to a data logger as a 4 to 20 mA signal corresponding to a pressure range of 20 to 30 inches of mercury.

2.4.2.3 Soil-gas Detection and Sampling

If required, the concentration of hydrogen, phosphine, and if necessary hydrogen cyanide gas will be sampled at the temperature monitoring wells with a hand held gas detector that can be fitted with one of three gas selective detectors in the manner described in WMU-specific FSP. The gas specific detectors will utilize an electrochemical cell designed to selectively measure the gas of interest. Gas selectivity is assured by the choice of electrode material, the cell potential, and electrolyte composition. Gas will be pumped at a constant flow rate through the appropriate selective detectors where it will either be oxidized or reduced. The resulting electrochemical current is proportional to the gas concentration and will be compared with a manufacturer's calibration curve to determine the concentration of the specific gas. The gas detector manufacturer will be Analytical Technology, Inc. (ATI) or equivalent. The phosphine detector model will be ATI's B16-32-1-1000-2 or equivalent. The hydrogen detector will be ATI's B16-

18-1-2000-1 or equivalent, and the hydrogen cyanide detector will be ATI's B16-22-1-0020-1 or equivalent.

2.5 Quality Control

Both field and laboratory QC checks will be employed to evaluate field contamination, the variability of field techniques and the performance of laboratory analytical procedures. QC checks will take the form of samples introduced into the analytical stream to enable evaluation of sampling and analytical accuracy and precision.

Such QC samples will be regularly prepared in the field and laboratory so that all phases of the sampling process are monitored. Sections 2.4.1 and 2.4.2 describe the QC samples that will be collected.

The accuracy and precision of temperature, pressure, and soil-gas measurements will be assured by proper instrument maintenance and calibration. Sections 2.6 and 2.7 describe the instrument/equipment testing, inspection, calibration and maintenance requirements.

2.5.1 Field Quality Control Samples

Field QC samples are collected and analyzed to verify that sample collection and handling has not affected the quality of the groundwater samples. All field QC samples should be prepared as regular investigation samples with regard to sample volume, containers, and preservation. The following field QC samples are collected:

Field duplicate sample - Duplicate groundwater samples are two samples collected from the same well at the same time and carried through all the steps of the sampling and analytical procedures in an identical manner. Duplicate samples will be collected at a frequency of one per every 20 samples. Table 3 identifies a specific well for each WMU that is to be used for collecting the duplicate samples. Different WMUs should be selected for each sampling event for duplicate samples so that over the course of several rounds of sampling, each WMU has had an associated well sampled as a duplicate QC sample.

Rinsate blank - Rinsate blanks are collected by pouring reagent grade purified water over or through field filtration and submersible pump setups to evaluate the effectiveness of field decontamination of sampling equipment. The blank is analyzed for the same analytical parameters as the groundwater samples. Rinsate blanks will be collected after decontamination and at a minimum frequency of one per every 20 samples.

parameters as the groundwater samples. Rinsate blanks will be collected after decontamination and at a minimum frequency of one per every 20 samples.

De-ionized water blank – De-ionized water blanks are aliquots of water collected directly from the field supply container and analyzed to determine de-ionized water quality. The blanks are collected at a frequency of one per quarterly sampling event and are analyzed for the same parameters as the groundwater samples.

EPA Region 10 may collect split samples in accordance with an EPA prepared split sampling plan.

2.5.2 Laboratory QA/QC Samples

Laboratory QA/QC samples will be collected by the sampling team for use as a measure of analytical accuracy and precision. The laboratory QA/QC sample will be collected following standard sampling and preparation techniques as described in the applicable FSP. Laboratory QC samples are collected at a frequency of one per sample delivery group or one per twenty samples collected. For each sample delivery group, a double-volume should be collected for one of the samples to allow the laboratory to prepare a matrix spike and either one matrix duplicate or matrix spike duplicate for each analytical method used.

Laboratory QC samples consist of laboratory method blanks, laboratory control samples, matrix spike, and laboratory duplicates or matrix spike duplicates. Requirements for laboratory QC samples are specified in the Laboratory's Quality Assurance Project Plan.

For method-specific QC criteria and samples (e.g., calibration blanks or initial calibrations), the criteria specified in the methods will be used. The methods will be performed as written. Any deviations, if allowed, must be approved by the FMC Environmental Manager in writing prior to implementation by the laboratory. Procedures will be in place for demonstrating that the laboratory is in control during each analytical measurement.

2.5.2.1 Laboratory Control Samples

The laboratory will be considered in control when data generated by analysis of control samples fall within laboratory prescribed limits. Data generated by analysis of control samples that falls outside the established control limits are judged to be generated during an "out-of-control" situation. These data are considered suspect and shall be repeated or reported with qualifiers. Laboratory control samples shall be analyzed for each analytical method when appropriate for the method. A laboratory control sample consists of either a control matrix spiked with the analytes of interest for this program or a certified reference material that contains the analytes of of the laboratory control sample(s) will be compared to control limits established by the laboratory for both precision and bias to determine usability of the data.

2.5.2.2 Method Blank

A method blank shall be analyzed with each batch of samples processed to assess contamination levels in the laboratory. The laboratory shall have guidelines in place for accepting or rejecting data based on the level of contamination in the blank. For a method blank to be acceptable for use with the accompanying samples, the concentration in the blank of any analyte of concern shall not be higher than the highest of either:

The MDL, or

Five percent of the regulatory limit for that analyte, or

Five percent of the measured concentration in the sample.

2.5.2.3 Matrix Spike/Matrix Spike Duplicates for Matrix Duplicate Samples

Procedures shall be in place for documenting the effect of the matrix on method performance. When appropriate for the method, there shall be at least one matrix spike (MS) and either one matrix duplicate (MD) or one matrix spike duplicate (MSD) per analytical batch. These procedures shall include preparation and analysis of matrix spikes, selection and use of surrogates for organic methods, and the method of standard additions for metal and inorganic methods. When the concentration of the analyte in the sample is greater than 0.1% (1,000 ppm), no spike is necessary. Procedures shall be in place for determining the precision of the method for a specific matrix. These procedures shall include analysis of matrix duplicates and/or matrix spike duplicates.

If, as in compliance monitoring, the concentration of a specific analyte in the sample is being checked against a regulatory concentration limit or action level, the spike shall be at or below the limit, or 10 times the background concentration (if historical data are available), whichever concentration is higher.

If the concentration of a specific analyte in a sample is not being checked against a limit specific for that analyte, then the analyst may spike the sample at the same concentration as the reference sample, at 20 times the estimated quantitation limit (EQL) in the matrix of interest, or at a concentration near the middle of the calibration range.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance Requirements

All equipment used in the conduct of this work will receive routine maintenance checks in order to minimize equipment breakdowns. Laboratory equipment is tested, inspected, and maintained in accordance with an established QA/QC plan.

2.6.1 Groundwater Field Measurements

Maintenance checks for groundwater field measurement instruments and equipment will generally coincide with calibration checks. Any equipment found to be operating improperly will be taken out of use, and a notation stating the time and date of this action will be made in a log-book. The equipment will be repaired, replaced, or recalibrated, as necessary, and the time and date of its return will also be recorded.

2.6.2 RCRA Cap Monitoring Measurements

Temperature and pressure sensors will receive an annual inspection to verify sensor components and connections to, and along, sensor cables have not become damaged by corrosion or other means. If damage is evident, then the affected component will be repaired or replaced. The hand held gas detector will be inspected prior to each use to assure the battery is charged, the gas pump is working, and to verify the detector indicates zero when monitoring air. Prior to each use, the detector pump will be activated, the battery energy level indicator will be inspected and the outlet will be monitored to determine is gas is being pumped through the detector. If the battery energy level indicator reads fully charged, if the gas pump is properly operating, and if the displayed concentration is zero, then the detector is ready for use. If not, the following corrective actions will be taken as needed: battery replacement; pump replacement; and detector recalibration or replacement.

2.7 Instrument/Equipment Calibration and Frequency

The requirements in this section pertain to the calibration of field equipment. Laboratory equipment will be calibrated in accordance with an established QA/QC plan and all calibrations will be performed in accordance standard operating procedures consistent with the QA/QC plan. Additional requirements related to laboratory instrument calibrations and frequency requirements are specified in the laboratory QA/QC plan. All calibrations of field equipment will be recorded in appropriate log-books. Table 5 provides a summary of field equipment calibration requirements.

2.8 Inspection/Acceptance Requirements for Supplies and Consumables

Groundwater sample containers will be new or pre-cleaned and supplied by the laboratory performing sample analysis. All other supplies will be decontaminated prior to use in accordance with the equipment decontamination procedure presented in the applicable FSP. No consumable supplies are required to execute the temperature and pressure monitoring program.

TABLE 5
SUMMARY OF FIELD EQUIPMENT CALIBRATION REQUIREMENTS

Field Measurement	*Instrument*	*Calibration Procedure*	*Calibration Frequency*	*Precision/ Criteria*
Water Level Survey	Electrical Water Probe Steel Tape	Reference to Steel Tape Reference to New Tape	Periodically Periodically	0.05 ft 0.01 ft
Water pH	pH Meter	2-point Buffer Solutions	Daily	0.1 pH unit
Specific Conductance	Conductivity Meter	KCl Reference Solution	Daily	±1%
Turbidity	Turbidity Meter	2-point Factory-Supplied Turbidity Standards	Daily	±0.1% full scale or ±0.05% NTU (1)
Water Temperature	Thermometer	Factory Calibration; periodic reference to boiling water at known atmospheric pressure	Annually	0.5°C
Temperature	Resistance Temperature Detector	Immersion in ice bath and immersion in tap water with comparison to a mercury thermometer	Annually	Measured T equal ± 0.5 C
Pressure	Diaphragm Pressure Sensor	Ship to manufacturer for certified recalibration	Annually	Resolution equal 1.5 kPa
Hydrogen	Portable Gas Detector	Ship to manufacturer for certified recalibration*	Annually	Detection limit 30 ppm
Phosphine	Portable Gas Detector	Ship to manufacturer for certified recalibration*	Annually	Detection limit 10 ppb
Hydrogen Cyanide	Portable Gas Detector	Ship to manufacturer for certified recalibration*	Annually	Detection limit 20 ppb

(1) The precision of the turbidity meter is the greater of 0.1% full scale or 0.05% of measurement in NTU, according to the manufacturer (LaMotte, Inc.).

2.9 Data Acquisition Requirements (Non-direct Measurements)

To meet groundwater and cap monitoring objectives at the FMC Facility, no data from non-direct measurements are required.

2.10 Data Managment

Data from both the field and the laboratory will be managed during this project. Field data will consist of field notebooks and chain of custody forms. Notebooks and chain of custody forms will be retained by the groundwater sampling contractor until the end of each quarterly sampling event, then forwarded to the FMC Environmental Manager for retention.

The laboratory documentation required for each sample delivery group depends on the anticipated level of review. Section 2.10.1 presents the documentation requirements of data validation and Section 2.10.2 presents the documentation requirements for data review. The Groundwater Sampling Contractor will maintain the analytical database.

Temperature and pressure monitoring data and gas sampling data will consist of data files from the temperature and pressure data logger and field notebooks from the gas sampling activities. Data logger reports and field notebooks will be forward by monitoring personnel to the FMC Environmental Manager for retention.

2.10.1 Laboratory Documentation for Data Validation

The following documentation will be provided by the laboratory for each sample delivery group scheduled for validation:

1. Case Narrative

2. Chain of Custody Documentation

3. Summary of Results

4. QA/QC Result Summaries

5. Raw Data

The format and detailed content of the laboratory documents will support validation of the data in accordance with EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 1994). An electronic data deliverable will be provided by the laboratory in a file format specified by FMC that is compatible with dBase III software. The deliverable will contain the fields specified in Table 5. Data packages for full validation will be forwarded by the laboratory to the data validation contractor. At the same time, a copy of items 1 through 4 will be forwarded to the FMC Environmental Manager for retention.

2.10.2 Laboratory Documentation for Data Review

Each sample delivery group of laboratory data not planned for validation will include items 1 through 4 described above in the same level of detail as required if the data were to be validated. Item 5, Raw Data, is not required. An electronic data deliverable will be provided by the laboratory in a file format specified by FMC. The deliverable will contain the fields specified in Table 6. Items 1 though 4 will be forwarded to the FMC Environmental Manager for retention.

3. ASSESSMENT/OVERSIGHT

Annual surveillance of monitoring activities will be conducted. The surveillance will be conducted by the FMC Environmental Manager or his designee. The field surveillance will focus on adherence to procedures outlined in the FSP and will include field observation of sampling procedures and selected documentation (e.g., field log-books). Laboratory audits will be conducted in accordance with the laboratory quality assurance plan. Field surveillance reports and laboratory audit reports will be forwarded to the FMC Environmental Manager. Audit findings which require corrective action and follow-up will be documented and tracked and will have resolution verified by the FMC Environmental Manager.

3.1 Assessments and Response Actions

If it appears that field or laboratory data are in error, the error(s) or potential error(s) will be documented and appropriate corrective action(s) will be taken. Corrective actions may include one or more of the following:

- Measurements may be repeated to check the error
- Calibrations may be checked and/or repeated
- Instrument/equipment may be replaced or repaired
- New samples may be collected, and/or samples may be reanalyzed.

All field and laboratory personnel will be responsible for identification of problems and implementation of corrective actions. During field and laboratory activities, problem descriptions and corrective actions taken will be thoroughly detailed and entered into notebooks.

TABLE 6
DATABASE FIELD ACRONYMS AND DESCRIPTIONS

DATABASE FIELD NAME	Type	Size	FULL NAME	DESCRIPTION
STA_ID	Text	12	Station ID:	well number, etc. (i.e., F308300 or S308108)
AGENCY	Text	8	Agency	investigating party (EPA)
SAMP_DATE	Date/Time	8	Sample Date	date sample was taken
SAMP_ID	Text	8	Sample ID	unique identification number given to each sample
WTR_DEP	Number (Double)	8	Water Depth	depth to where water is found from casing reference notch (in ft.)
WTR_ELEV	Number (Double)	8	Water Elevation	elevation above mean sea level of groundwater (in ft.)
CHEM_NAME	Text	36	Chemical Name	name of chemical
CAS_NO	Text	12	Chemical Abstract Service Number	number that is given to identify a unique chemical by the Chemical Abstract Service
CONC_DET	Number (Double)	8	Concentration Detection	chemical concentration that was detected
QUAL	Text	4	Qualifier	laboratory qualifier given to each sample
UNITS	Text	12	Units	units of measurement
QUAL_VAL	Text	4	Validation Qualifier	qualifier assigned as a result of data validation
QUAL_CODE	Text	6	Code Qualifier	code used by validation to indicate why a qualifier was assigned
VAL_LVL	Text	4	Validation Level	level or extent of validation done
CHEM_NO	Number (Double)	8	Chemical Number	chemical number given by FMC for database sorting

TABLE 6
DATABASE FIELD ACRONYMS AND DESCRIPTIONS (Cont.)

DATABASE FIELD NAME	Type	Size	FULL NAME	DESCRIPTION
SAMP_TYPE	Text	4	Sample Type	e.g., groundwater (GW), surface water (SW) or potential source (PS) sample
LAB_NAME	Text	12	Laboratory Name	name of laboratory that performed the analyses
LAB_ID	Text	12	Laboratory Identification	identification number given to a sample by laboratory
QUAL_ANAL	Text	4	Analysis Qualifier	lab-assigned qualifier (see Qualifier Description)
QUAL_SAM	Text	8	Qualifying Sample	sample qualifier indicating that sample is not representative (see Qualifier Description)
AN_DATE	Date/Time	8	Analytical Date	date sample was analyzed for constituents
AN_METHOD	Text	20	Analytical Method	method used for analyzing chemicals
PKG_NAME	Text	9	Package Name	laboratory sample delivery group (SDG)
ACTUAL_VAL	Number (Double)	8	Actual Value	actual value shown for accuracy, used only for radiological
ACCURACY	Number (Double)	8	Accuracy	± accuracy (for rad samples)
RPT_LIM	Number (Double)	8	Reporting Limit	laboratory required reporting limit
FILE_NAME	Text	8	File Name	chronological name of an event

If the FMC Environmental Manager, FMC Analytical Laboratory Contractor QA officer, or other project personnel become aware of any problems in sample collection or analysis that cannot be corrected in the field or laboratory, they will initiate formal corrective action and notify the FMC Environmental Manager and prepare a Corrective Action Report. The FMC Environmental Manager will also be notified of problems identified and corrective actions taken during field activities. Appropriate corrective actions will be determined on a case-by-case basis.

3.2 Reports to Management

The surveillance and audit findings will be included in the corresponding groundwater quarterly groundwater monitoring results and data validation reports. Each report, as appropriate, will include a section which provides an overall assessment of the performance of the field and laboratory programs based on the audits.

4. DATA VALIDATION AND USABILITY

The following subsection presents requirements for activities that occur after the data collection phase of the project is complete.

4.1 Data Review, Validation, and Verification Requirements

All data generated by this project will be reviewed by the FMC Environmental Manager to ensure they are consistent with previous results and previously observed data trends.

For laboratory generated analytical data, ten percent of the analytical results or one sample delivery group, whichever is greater, will be validated. The other ninety percent will receive a QC and Blank Check to ensure the sampling and analytical program are operating within control limits. The QC and Blank Check will include examination of field duplicate sample results and laboratory QA/QC sample results. All electronic copy entries will be verified against hard-copy results reported by the laboratory and field sampling personnel, unless the electronic copy is produced using the same laboratory information management system.

4.2 Validation and Verification Methods

The required data review may be conducted informally during report preparation; it should include a comparison of the current and previous quarter results. The QC and Blank Check will be conducted by compiling the results of field duplicate samples and laboratory QA/QC samples and assessing whether the sampling and analytical processes are operating within control limits. Generally, these processes are considered within control limits if the relative percent difference between field duplicate pairs is less than 30 percent and if the laboratory QA/QC sample results meet the criteria specified in the applicable method. Data validation will be conducted in accordance with the EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA 1994).

4.3 Reconciliation with User Requirements

To meet the project objectives specified in Section 1.5, the data analyses specified in DQO Step 5 of this QAPjP will be performed. If sufficient data of known quality have been generated to complete these analyses, then the project objectives have been met.

5. REFERENCES

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FMC, 1998d. Phase IV Ponds Closure Plan," FMC Corporation, Pocatello, Idaho, August 1998. Draft revision in preparation; to be issued April 2002.

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FMC, 2000. "Pond 9E Closure Plan," FMC Corporation, Pocatello, Idaho, Revised January 2000.

Attachment 10-2

FIELD SAMPLING PLANS (FSPs)

Attachment 10-2a

Field Sampling Plan for RCRA Groundwater Monitoring

Field Sampling Plan for RCRA Groundwater Monitoring

1. INTRODUCTION

1.1 Background

This Field Sampling Plan (FSP) provides sampling and analysis procedures for implementation of the RCRA interim status groundwater monitoring program for waste management units (WMUs) located at the former FMC Corporation Elemental Phosphorus Plant in Pocatello, Idaho, including the RCRA post-closure care period. The facility ceased producing elemental phosphorus from phosphate ore in December 2001 and is currently being decommissioned by FMC.

The FSP contains procedures for sample collection, labeling, storage, shipment, chain-of-custody protocols, and quality assurance/quality control (QA/QC). The plan also specifies the analytical parameters and test methods. Implementation of these procedures will ensure that equipment and piping that has come into contact with hazardous waste has been properly decontaminated.

1.2 Previous Results

In accordance with the interim status requirements of RCRA pursuant to 40 CFR Part 265 Subpart F, groundwater monitoring wells associated with WMUs, are sampled and analyzed on a quarterly basis as part of an assessment monitoring program. The results of this program are presented in annual RCRA Interim Status Groundwater Monitoring Assessment reports.

The groundwater monitoring sample results are subjected to several statistical tests to determine if hazardous waste constituents from a waste management unit have entered the groundwater. One test compares the concentrations in downgradient wells with the concentrations in upgradient wells. A second test compares the mean concentrations with mean concentrations in previous years, and a third test compares concentrations in downgradient wells with downgradient well concentrations from previous years. Based on these tests, decisions are made concerning whether or not releases from WMUs have occurred.

Table 1 identifies each WMU and the associated RCRA upgradient and downgradient monitoring wells that are sampled.

TABLE 1
WMU-SPECIFIC RCRA GROUNDWATER MONITORING WELLS

		Monitoring Well I.D. Numbers	
WMU No.	**WMU Name**	**Upgradient**	**Downgradient**
3	Phossy Waste Surface Impoundment (Pond 15S)	165	113, 115 and 166
5	Slag Pit Sump	121	108, 122, 123
7	Phossy Waste Surface Impoundment (Pond 8S)	158,183	155, 156, 157
8	Phossy Water Clarifier Surface Impoundments (11S, 12S, 13S, and 14S) – Phase IV Ponds	167	104, 114, 131, and 168
9	Precipitator Slurry Drying Surface Impoundment (Pond 9E)	124, 113	126, 127, and 128
10	Phossy Waste Surface Impoundment (Pond 16S)	154	147, 148, and 149
11	Precipitator Slurry Surface Impoundment (Pond 8E)	167	104, 114, 131, and 168
14	Pond 17	173	171, 172, 180
15	Pond 18	174, 175	154, 176, 177, 178
	Pond 18, Cell A	174	154, 177, 178

2. SAMPLING OBJECTIVES

The objectives of sampling the monitoring wells associated with the WMUs are to:

- Collect samples representative of groundwater flowing beneath the WMU.
- Collect data that meets data quality objectives.
- Evaluate the potential impact to groundwater.
- Verify that a WMU is not leaking, and if it were to leak, to provide early warning.

To meet these objectives, data will be obtained to support several statistical tests designed to indicate whether or not the WMU is leaking.

3. SAMPLING LOCATIONS AND FREQUENCY

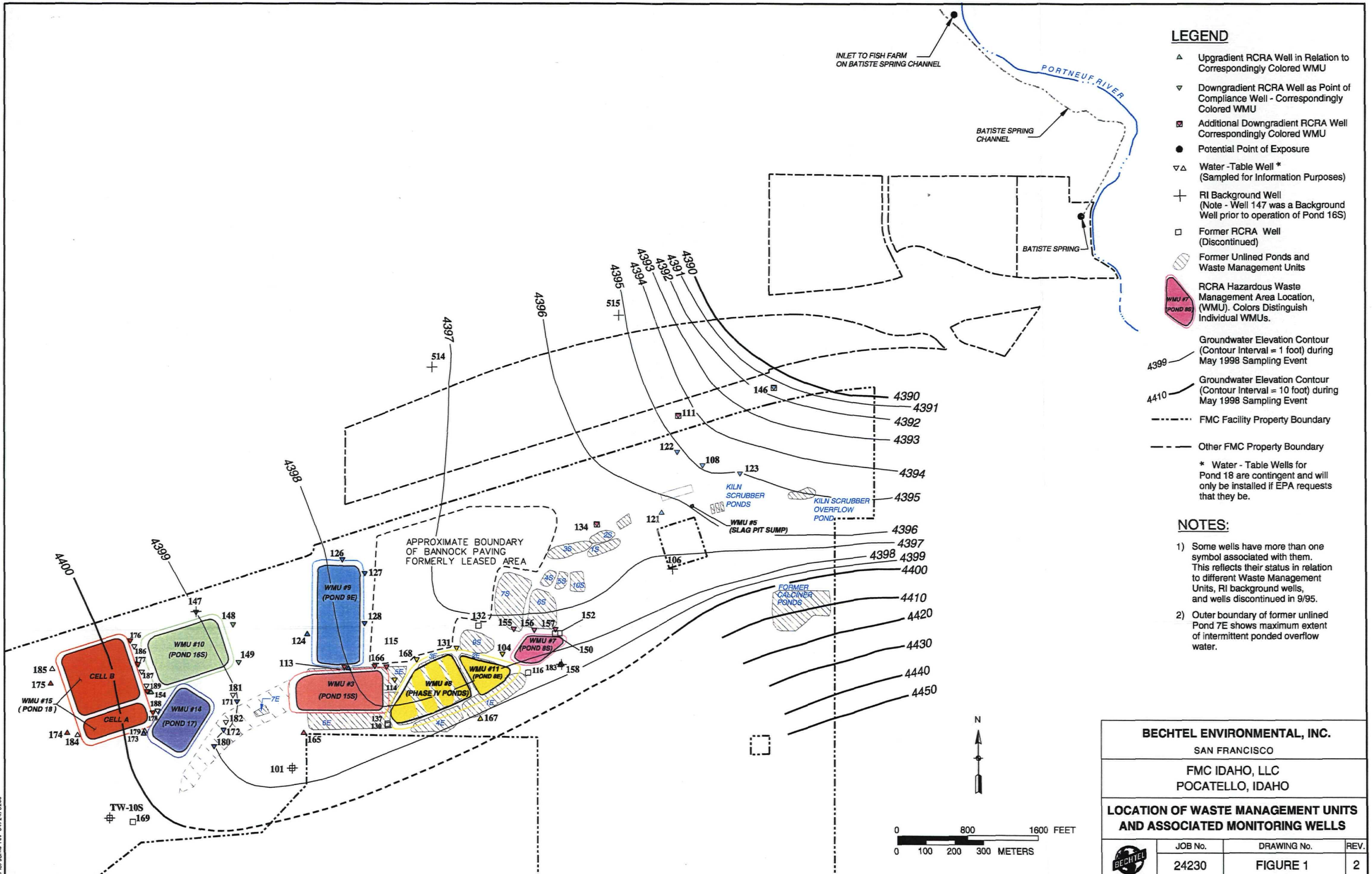
The location of upgradient and downgradient monitoring wells for each WMU is provided in Figure 1. Appendix A of this FSP provides a summary of the well construction details and well completion diagrams.

3.1 Groundwater Monitoring Well Samples

One groundwater monitoring well sample will be collected quarterly from each of the wells for each WMU listed in Table 1 in accordance with the procedures specified in Section 5. Each sample will then be submitted to the laboratory in accordance with the procedures specified in Section 6.

3.2 Field and Laboratory Quality Control Samples

Field and laboratory quality control (QC) samples will be prepared for each quarterly groundwater sampling event. The QC samples ensure the reliability and validity of the field collection methods and laboratory analyses conducted for each sampling event.


LEGEND
Upgradient RCRA Well in Relation to Correspondingly Colored WMU
Downgradient RCRA Well as Point of Compliance Well - Correspondingly Colored WMU
Additional Downgradient RCRA Well Correspondingly Colored WMU
Potential Point of Exposure
Water-Table Well * (Sampled for Information Purposes)
RI Background Well (Note - Well 147 was a Background Well prior to operation of Pond 16S)
Former RCRA Well (Discontinued)
Former Unlined Ponds and Waste Management Units
RCRA Hazardous Waste Management Area Location, (WMU). Colors Distinguish Individual WMUs.
Groundwater Elevation Contour (Contour Interval = 1 foot) during May 1998 Sampling Event
Groundwater Elevation Contour (Contour Interval = 10 foot) during May 1998 Sampling Event
FMC Facility Property Boundary
Other FMC Property Boundary
* Water - Table Wells for Pond 18 are contingent and will only be installed if EPA requests that they be.
NOTES:
1) Some wells have more than one symbol associated with them. This reflects their status in relation to different Waste Management Units, RI background wells, and wells discontinued in 9/95.
2) Outer boundary of former unlined Pond 7E shows maximum extent of intermittent ponded overflow water.
INLET TO FISH FARM ON BATISTE SPRING CHANNEL
PORTNEUF RIVER
BATISTE SPRING CHANNEL
BATISTE SPRING
APPROXIMATE BOUNDARY OF BANNOCK PAVING FORMERLY LEASED AREA
KILN SCRUBBER PONDS
KILN SCRUBBER OVERFLOW POND
WMU #5 (SLAG PIT SUMP)
FORMER CALCINER PONDS
WMU #9 (POND 9E)
WMU #10 (POND 16S)
WMU #14 (POND 17)
WMU #15 (POND 18)
CELL A
CELL B
WMU #3 (POND 15S)
WMU #8 (PHASE IV PONDS)
WMU #11 (POND 8E)
WMU #7 (POND 8S)
TW-10S
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
FMC IDAHO, LLC
POCATELLO, IDAHO
LOCATION OF WASTE MANAGEMENT UNITS AND ASSOCIATED MONITORING WELLS
JOB No. 24230
DRAWING No. FIGURE 1
REV. 2
0 800 1600 FEET
0 100 200 300 METERS

3.2.1 Field Quality Control Samples

Field QC samples are collected and analyzed to verify that sample collection and handling has not affected the quality of the groundwater samples. All field QC samples should be prepared as regular investigation samples with regard to sample volume, containers, and preservation. The following field QC samples are collected:

- *Field duplicate sample* - Duplicate groundwater samples are two samples collected from the same well at the same time and carried through all the steps of the sampling and analytical procedures in an identical manner. The original sample and the field duplicate are uniquely numbered so that the laboratory cannot identify the duplicate. Duplicate samples will be collected at a frequency of one per every 20 samples. Table 2 identifies a specific well for each WMU that is to be used for collecting the duplicate samples. Different WMUs should be selected for each sampling event for duplicate samples so that over the course of several rounds of sampling, each WMU has had an associated well sampled as a duplicate QC sample.

- *Rinsate blank* - Rinsate blanks are collected by pouring reagent grade purified water over or through field filtration and submersible pump setups to evaluate the effectiveness of field decontamination of sampling equipment. The blank is analyzed for the same analytical parameters as the groundwater samples. Rinsate blanks will be collected after decontamination and at a minimum frequency of one per every 20 samples.

- *De-ionized water blank* – De-ionized water blanks are aliquots of water collected directly from the field supply container and analyzed to determine de-ionized water quality. The blanks are collected at a frequency of one per quarterly sampling event.

EPA Region 10 may collect split samples in accordance with an EPA prepared split sampling plan.

3.2.2 Laboratory Quality Control Samples

Laboratory QC samples consist of laboratory method blanks, laboratory control samples, matrix spike, and laboratory duplicates or matrix spike duplicates. Requirements for laboratory QC samples are specified in the Quality Assurance Project Plan (QAPjP). Laboratory QC samples are collected at a frequency of one per sample delivery group or one per twenty samples collected. For each sample delivery group, a double-volume should be collected for one of the samples to allow the laboratory to prepare a matrix spike and either one matrix duplicate or matrix spike duplicate for each analytical method used. Table 2 identifies a specific well for each WMU that is to be used for collecting the laboratory QC samples. Different WMUs should be selected for each sampling event so that over the course of several rounds of sampling, each WMU has had an associated well sampled for laboratory QC samples.

4. SAMPLE DESIGNATION

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have preassigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information:

- Facility name.
- Sample number.
- Date of collection.
- Time of collection.
- Analytical parameter.
- Method of preservation.

Every sample, including samples collected from a single location but going to separate laboratories, will be assigned a unique sample number.

5. SAMPLING EQUIPMENT AND PROCEDURES

This section describes the procedures to be used to collect groundwater samples. All samples will be collected in accordance with the procedures presented in this section and handled in accordance with the procedures presented in Section 6. Table 3 identifies a list of sampling equipment and consumable supplies and whether or not equipment is disposable or requires decontamination.

TABLE 2

WELLS USED FOR COLLECTION OF QUALITY CONTROL SAMPLES[a]

WMU No.	WMU Name	Wells - Field Duplicates	Detectable Parameter(s)	Wells – Laboratory QC	Low Concentration Parameter(s)
3	Pond 15S	166	Fluoride	165	Arsenic, fluoride, selenium
5	Slag Pit Sump	None specified	N/A	None specified	N/A
7	Pond 8S	157	Arsenic, fluoride	158	Arsenic, selenium
8	Phase IV Ponds	168	Arsenic, fluoride, selenium	131	Arsenic, fluoride, selenium
9	Pond 9E	126	Arsenic, fluoride, selenium	124	Arsenic, fluoride, selenium
10	Pond 16S	154	Fluoride	147	Arsenic, fluoride, selenium
11	Pond 8E	168	Arsenic, fluoride, selenium	131	Arsenic, fluoride, selenium
14	Pond 17	180	Arsenic	173	Arsenic, selenium
15	Pond 18	178	Selenium	177	Arsenic, selenium

[a] Note: The wells specified in this table are used to collect the field duplicate sample or laboratory QC sample and should be rotated for sampling events such that each WMU has an opportunity for QC samples.

TABLE 3

FIELD EQUIPMENT AND SUPPLY LIST

Equipment Item			Consumable Supplies
Item	Decon	Dispose	
Water level electronic sounder	√	-	Field logbook
Steel tape	√	-	Sample labels
Electric submersible pump	√	-	Custody seals
Bailer	√	-	Sample containers
Hand pump	√	-	Preservatives (H_2SO_4, HNO_3)
Plastic or teflon tubing	√	√	Ice chest
Digital thermometer	√	-	Ice
pH meter	√	-	Chain-of-custody forms
Conductivity meter	√	-	Styrofoam peanuts
Turbidity meter	√	-	Bubble wrap
Nitrile gloves	-	√	Nylon strapping tape
Filters	-	√	Indelible pen

5.1 Field Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. At a minimum, the following sampling information will be recorded:

- Sample location, station location, and description.
- Sample number.
- Sampler's name(s).
- Date and time of sample collection.
- Type of sample (e.g., regular, QA sample designation).
- Type of sampling equipment used.
- Onsite measurement data (e.g. temperature, pH, conductivity). The data should include the numerical value and the units of each measurement.
- Field observations and details important to analysis or integrity of samples (e.g., heavy rains, odors, colors).
- Type of preservation used. (Note: Reagent or high performance liquid chromatography (HPLC) grade materials will be used for sample preservation.)

In addition, the following will be recorded in a separate field book:

- Chain-of-custody form numbers and chain-of-custody seal numbers
- Shipping arrangements (i.e., Federal Express air bill number).
- Recipient laboratory(ies).

5.1.1 Sample Coding in Field Logbooks

The station location will be described in the logbook as follows, in a manner consistent with the conventions used during the remedial investigation:

A two-digit number will be used to indicate the year in which the sample was collected, for example "97" indicates a sample was collected in 1997. This digit will be followed by two others indicating the month in which the sample was collected, for example "11" indicates a sample was collected in November. Finally, three digits will identify the well from which the sample was collected. The location description, 9711156, indicates a sample collected from Well 156 in November 1997.

A two-letter code will be used to identify the sample matrix. These are matrix codes such as GW for groundwater.

A three-digit or descriptive letter combination will be used to identify the boring or well location from which a sample is collected. Samples collected for field QC will be identified by a three-digit or descriptive letter combination. Numbers for well locations and field QC will be grouped as follows:

- FMC Facility: 100 series numbers.
- Field Duplicate: 600 series starting with 600 for each sampling event and continuing consecutively during the event for duplicates collected.
- Rinsate: 700 series numbers.
- Distilled/de-ionized water blank: FDI.

The date of collection will be indicated in mm/dd/yy format, and the time will be indicated in accordance with the military convention. The analytical parameter and method of preservation will be indicated in an unambiguous shorthand, such as F^- for fluoride.

Logbooks will be rain-resistant bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in black, waterproof ink, and signed by the individual making the entries. The person recording the notes will sign and date the bottom of every page in the field notebook. Changes will be initialed and dated. Unused portions of logbook pages will be crossed out, signed, and dated by the assigned individual at the end of each workday. Language will be factual, objective, and free of personal opinions or inappropriate terminology. In addition to the sampling information, the following specifics will also be recorded in the field logbook:

- Team members.
- Time of site arrival/entry on site and time of site departure.
- Other personnel on site.
- Any deviations from sampling plans, site safety plans, and QAPjP procedures.

- Any changes in personnel and responsibilities as well as reasons for the changes.
- Equipment calibration and equipment model and serial number.

5.1.2 *Sample Coding on Sample Containers*

One objective of the field sampling program is to deliver "blind" sample containers to the laboratory for analysis. That is, the laboratory should not be knowledgeable of the well from which the groundwater sample was collected. Nor should the laboratory be able to recognize whether a container holds a regular groundwater sample or a field QC sample on the basis of the coding system used to label the sample container.

The sample team leader will, therefore, create a unique number for each sample container. The field logbook will contain a matrix that cross-references this container number to the sample code described in Section 5.1.1.

Upon receipt of analytical results from the laboratory, the groundwater sampling contractor will re-associate these analytical data with the true sample code in the groundwater monitoring database using the cross-references recorded in the field log book. These re-associations will be fully verified.

5.2 Groundwater Monitoring Well Sample Collection

5.2.1 *Water Level Measurements*

Water levels in each well will be established in one 4- to 6-hour period before purging and sampling. If well heads are accessible, wells will be sounded for depth to water from the top of the casing and total well depth prior to purging. An electronic sounder, accurate to the nearest (+/–) 0.01 feet, will be used to measure depth to water in each well. When using an electronic sounder, the probe is lowered down the casing to the top of the water column. The graduated markings on the probe wire are used to measure the depth to water from the surveyed point on the rim of the well casing. Typically, the measuring device emits a constant tone when the probe is submerged in standing water, and most electronic water level sounders have a visual indicator consisting of a small light bulb or diode that turns on when the probe encounters water. Water level sounding equipment will be decontaminated before and after use in each well. To the extent practicable, water levels will be first measured in wells that have the least amount of known contamination first.

5.2.2 Well Purging

All wells will be purged prior to sampling. Three to five casing volumes of water will be purged using an electric submersible pump or hand pump depending on the diameter and capacity of the well. This traditional approach to purging and sampling groundwater will continue to be used even though low-flow rate purging is becoming widely used as a valid technique (EPA 1995). Switching to the low-flow purging technique will not be considered at this time because:

- Potential problems with data comparison and interpretation of temporal trends due to differences in the techniques.
- Increased time may be required for purging and sampling at slow flow-rates and additional equipment may be needed. An evaluation would be necessary to determine if the low-flow purging technique can be practically implemented.
- A site-specific groundwater sampling study would be necessary, collecting additional metals data from individual wells using both the traditional purging and sample filtering and using the low-flow purging to determine if there is a significant difference between the metals values using the two techniques.
- Some field studies comparing traditional purging techniques with low-flow rate pumping have been inconclusive (EPA 1995).

When pumps are used for purging, clean flexible plastic or Teflon tubing will be used for groundwater extraction. Pumps will be placed approximately 10 feet below the water level in the well to permit reasonable drawdown and to prevent cascading conditions. If necessary, purge water will be collected into a measured container to record the purge volume.

Casing volumes will be calculated based on total well depth and standing water level; casing diameter will be based on the results of previous measurements. Monitoring well construction details are summarized in Table 2 along with water elevations determined at the time of construction.

One casing volume will be calculated as:

$$V = \pi R^2 h / 19.25$$

where:

V is the volume of one well casing of water (in gallons, 1 gallon = 7.48 ft^3);

R is one-half the inner diameter of the well casing (in inches); and

h is the total depth of water in the well (in feet).

Prior to the start of sampling and after each well casing volume is purged, water temperature, pH, specific conductance, and turbidity will be measured using field test meters. The measurements will be recorded. Samples will be collected after these parameters have stabilized, indicating representative formation water is entering the well. Three consecutive measurements, which display consistent values of all parameters will be taken prior to sampling. Samples will be collected after three well casing volumes if parameters have stabilized. Typically, the temperature should not vary by more than (+/–)1°C, pH by more than 0.2 pH units, and specific conductance by more than 10 percent from reading to reading. No water that has been tested with a field meter probe will be collected for chemical analysis. If these parameters have not stabilized after five casing volumes have been purged, purging will cease, a notation will be recorded in the field logbook, and samples will be collected. In accordance with Section 5.1, depth-to-water measurements, field measurements of parameters, and purge volumes will be recorded in the field logbook.

If a monitoring well dewaters during purging and three casing volumes are not purged, that well will be allowed to recharge up to 80 percent of static water column, and dewatered once more. After water levels have recharged to 80 percent of the static water column, groundwater samples will be collected.

All field meters will be calibrated according to manufacturers' guidelines and specifications prior to beginning field-work. Field meter probes will be decontaminated before and after use at each well.

5.2.3 Well Sampling

Groundwater samples will be collected from the monitoring wells specified in Table 1. Prior to sampling, the water level in the well will be measured as described in Section 5.2.1 and wells will be purged as described in Section 5.2.2. All wells will be sampled within 24 hours after purging. Clean nitrile gloves will be worn while collecting samples. Groundwater samples will be collected directly from the pump tubing into the appropriate sample container, preserved as described in Section 6, and chilled and processed for shipment to the laboratory. When transferring samples, care will be taken not to touch the discharge tubing to the sample container.

Groundwater samples with turbidity levels >10 NTU (after stabilization of field parameters pH, specific conductance, and temperature) will be analyzed for both total and dissolved metals. Samples for dissolved metals analyses will be filtered in the field using a Geotech Masterflex peristaltic pump or equivalent. Groundwater samples will be field-filtered using the following procedures:

1. Samples will be collected directly into or transferred from the bailer or pump to a pre-cleaned unpreserved polyethylene sample container.
2. The sample will then be filtered using tygon, viton, or other compatible tubing connected to a 0.45 micron disposable filter. The sample will be filtered directly into a sample container containing preservatives.
3. The type of container, volume of water to be collected, and preservation method will be the same for filtered and unfiltered samples, which will be analyzed for metals.
4. Filters will be discarded and replaced after each use. Tubing used for filtration will be discarded after each use.

Section 6 gives detailed procedures for sample packaging, labeling, and shipping. All groundwater sampling equipment will be decontaminated before and after each sample is collected using procedures outlined in Section 5.6.

5.3 Duplicate Groundwater Monitoring Well Sample Collection

When collecting duplicate groundwater samples, bottles with two different sample designations will be alternated in the filling sequence. Duplicate samples will be submitted blind to the analytical laboratory. To assure this, duplicate samples from the same monitoring well will be collected in separate samples bottles with two unique sample designations with no indication of the well from which the samples are collected.

5.4 Laboratory QA/QC Sample Collection

When collecting laboratory QA/QC samples, a single sample designation will be assigned to a double-volume sample.

5.5 Conductivity, Temperature, Turbidity and pH Measurements

Electrical conductivity, water temperature, turbidity and pH measurements will be made in the field during purging, when a water sample is collected. The water sample will be placed in a bottle or jar used solely for field testing. A field pH meter with a combination electrode or equivalent will be used for pH measurement. A field conductivity meter will be used for specific conductance measurements. A nephelometer-type turbidimeter will be used for turbidity measurements. Temperature measurements will be performed using standard thermometers or equivalent temperature meters. Combination instruments capable of measuring two or all three of the parameters may also be used. All instruments will be calibrated in accordance with manufacturers' recommendations. If conductivity standards or pH buffers are used in the calibration, their values will be recorded in the field notebook. The sample testing jar and all probes will be thoroughly cleaned and rinsed with distilled water prior to any measurements.

5.6 Equipment Decontamination Procedure

Decontamination of sampling equipment will be consistently conducted in a manner to ensure the quality of samples collected. The resulting decontamination fluids and residual material will be handled in the manner described in Section 7 to avoid recontamination.

All equipment that comes into contact with potentially contaminated water will be decontaminated. Sampling equipment will be washed with a non-phosphate detergent scrub, followed by fresh water and de-ionized water rinses. Equipment will be decontaminated on pallets or plastic sheeting, and clean equipment will be used immediately or stored on plastic sheeting in uncontaminated areas. Materials to be stored more than a few hours will also be covered.

Sampling equipment will be cleaned at the sampling location using non-phosphate detergent followed by a fresh water rinse and a de-ionized water rinse.

Sampling equipment will be decontaminated as follows:

1. The exterior surfaces and accessible interior portions of submersible and hand pumps will be cleaned with a non-phosphate detergent and water prior to each use. Inaccessible interior portions of the pumps will be cleaned prior to each use by purging water through the pump and discharge lines. Hoist rods and cables used in connection with submersible pumps shall be cleaned using the procedures described above. An

effort will be made to sample the wells in the order of least to most contaminated to further minimize the risk of sample cross-contamination.

2. New bailers and tubing may be used for collection of the groundwater samples or reusable bailers and tubing will be cleaned at the start of the job by steam cleaning and between wells with a non-phosphate detergent wash followed by a tap water, and finally, a de-ionized water rinse.

3. Steel tapes, water probes, water level indicators, transducers, thermometers, and water quality meters will be rinsed in de-ionized water cleaned in a detergent solution, rinsed once in fresh water, and after each use.

4. Filters used in field-filtration of groundwater samples will be discarded. Rinsate blanks will be collected periodically from the field filtration and submersible pump setups. Tubing used in filtration will be new.

6. SAMPLING HANDLING AND ANALYSIS

This section describes sample handling procedures including sample containers, sample preservation, shipping requirements and holding times, and sample analysis. These procedures are designed to ensure that samples are preserved and transported to the laboratory in a manner that is consistent and maintains sample integrity. Table 4 summarizes analytical parameters, sample containers, sample volume, preservatives, and holding times.

TABLE 4
SAMPLE HANDLING AND PRESERVATION PROCEDURES

Parameter	Recommended Container	Preservative	Maximum Holding Time
Ammonia	1-liter polyethylene bottle	H_2SO_4 to pH<2; Cool to 4°C	28 days
Water Quality (Cl^-, F^-, NO_3^-, SO_4^{2-})	1-liter polyethylene bottle	Cool to 4°C	6 months
Metals (As, Cd, K, Se)	2 1-liter polyethylene bottles	HNO_3 to pH<2[a], Cool to 4°C	6 months
Orthophosphate	1-liter polyethylene bottle	Cool to 4°C	48 hours
Total Phosphorus (Slag Pit Sump only)	1-liter polyethylene bottle	Cool to 4°C	30 days
Elemental Phosphorus (Pond 8S and Slag Pit Sump only)	½-liter amber glass bottle; zero head space	Cool to 4°C	5 days for extraction

[a] If field filtered due to turbidity the sample will be preserved with HNO_3 to pH<2.

6.1 Sample Handling

Pre-cleaned sample containers will be used for sample collection. Preservatives, if required, will be added to the containers prior to shipment of the sample containers to the laboratory.

6.2 Sample Custody

6.2.1 Custody Seals.

Custody seals will be used to preserve the integrity of each sample container and cooler from the time it is collected until it is opened by the laboratory. A custody seal will be placed on each sample container after collection such that it must be broken to open the container. Two or more custody seals will be signed, dated, and placed on the front and back of the sample cooler lid prior to transport.

6.2.2 Chain-of-Custody Records.

Chain-of-custody forms will be used for all samples delivered to the laboratory to ensure that the integrity of the samples is maintained. Each form will include the following information:

- Sample number.

- Date of collection.
- Time of collection.
- Analytical parameter.
- Method of preservative.
- Number of sample containers.
- Shipping arrangements and airbill number, if applicable.
- Recipient laboratory.
- Signatures of parties relinquishing and receiving the sample at each transfer point.

Whenever a change of custody takes place, both parties will sign and date the chain-of-custody form, with the relinquishing person retaining a copy of the form (in the case of a commercial carrier, such as Federal Express, the relinquishing person should note the carriers unique identification for the shipment on the chain-of-custody form). The party that accepts custody will inspect the custody form and all accompanying documentation to ensure that the information is complete and accurate. Any discrepancies will be noted on the chain-of-custody form.

6.3 Sample Shipment

All sample containers will be placed in a strong, outside shipping container. The following outlines the packaging procedures that will be followed.

1. When ice is used, secure the drain plug of the cooler with fiberglass tape to prevent melting ice from leaking out of the cooler.
2. Line the cooler with bubble wrap, as needed, to prevent breakage during shipment.
3. Check screw caps for tightness and, if not full, mark the sample volume level of liquid samples on the outside of their sample bottles with indelible ink.
4. Custody-seal all container tops.
5. Affix sample labels onto the containers and write sample number on container with indelible ink.
6. Wrap all sample containers in bubble wrap, as needed, to prevent breakage.

All samples will be placed in coolers with the appropriate chain-of-custody form. All forms will be enclosed in a large plastic bag and affixed to the underside of the cooler lid. Empty space in the cooler will be filled with bubble wrap or Styrofoam peanuts to prevent movement and breakage during shipment. Ice used to cool samples will be placed on top and around the samples to chill them to the correct temperature. Each ice chest will be securely taped shut with nylon strapping tape; and custody seals will be affixed to the front and back of each cooler lid.

6.4 Sample Analysis

Required sample analyses and methods are summarized in Table 5.

7. DISPOSAL OF WASTE

In the process of collecting groundwater samples, different types of potentially contaminated wastes will be generated. The expected wastes are:

- Used personal protective equipment (PPE).
- Disposable sampling equipment.
- Decontamination fluids.
- Purged groundwater.

This section describes the procedures that will be followed to handle these wastes. The procedures have enough flexibility to allow the sampling team to use its professional judgment on the proper method for the disposal of each type of waste generated at each sampling location.

7.1 Used PPE and Disposable Sampling Equipment

Used PPE and disposable equipment will be bagged and accumulated in a dumpster onsite for disposal in an onsite or off-site landfill. Any PPE and disposable equipment that could be considered reusable will be rendered inoperable before disposal.

7.2 Disposal of Decontamination Fluids and Purged Groundwater

Decontamination fluids and purged groundwater will be containerized, if necessary, and either treated onsite or managed appropriately in compliance with RCRA regulations. Due to the low levels of contaminants in groundwater (i.e., analytical results of previous groundwater samples have not exceeded the Toxicity Criteria presented in 40 CFR Part 261 Subpart C), the decontamination fluids and groundwater will be managed as non-hazardous waste water.

TABLE 5
SUMMARY OF REQUIRED ANALYSES

Parameter	Method Number	Method Type	Method Detection Limit (ppm)
Ammonia	350.3* (a)	Potentiometric, Ion Selective Electrode	0.2
Potassium	6010B (b)	Inductively Coupled Plasma Atomic Emission Spectrometry	5
Chloride	325.3* (a)	Titrimetric (mercuric nitrate)	all ranges
Fluoride	340.2* (a)	Potentiometric, Ion Selective Electrode	0.1
Metals (As, Cd, Se)	6010B (b)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.005, 0.005, 0.005
Nitrate	353.2* (a)	Colorimetric (brucine sulfate)	0.1
Total Phosphorus	365.4 (a)	Colorimetric	0.1
Orthophosphate	365.2* (a)	Colorimetric (ascorbic acid)	0.1
Phosphorus (P_4)	7580	Gas Chromatography/ Mass Spectrometry	0.00005
Sulfate	375.4* (a)	Gravimetric	5

(a) Methods for Chemical Analysis of Water and Wastes, EPA –600/4–79–020, Revision, March 1983. Method 300.0A or SW–846 Method 9056 may be used as an alternate method, if appropriate.

(b) Test Method for Evaluating Solid Waste, EPA SW–846, Third Edition, Update III, as revised through 1997.

* No equivalent SW–846 method

8. References

EPA, 1995. "Ground Water Sampling – A Workshop Summary", EPA/600/R-94/205, January 1995.

APPENDIX A

WELL CONSTRUCTION SUMMARIES

and

WELL COMPLETION DIAGRAMS

APPENDIX A

WELL COMPLETION DIAGRAMS

Tables 2A through 2H present a summary of well construction details. The Geologic Drill logs appear as an Appendix A in the appropriate Closure Plan.

WMU #3 (Pond 15S)

TABLE 2A
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Dia-meter (inches)
165	449,237	551,986	4,464.2	85.0	80.7	97.0	97.2	65.17	4
113	449,982	552,482	4,463.0	82.2	77.0	94.5	97.0	64,5	4
115	450,000	552,938	4,469.7	118.5	109.0	131.0	140.0	71.62	4
166	450,004	552,802	4,467.4	85.5	82.0	98.0	99.0	69.33	4

* Determined in November 1997 and reported in RCRA Interim Status 1997 Groundwater Monitoring Assessment, February 1998.
^ Feet Above Mean Sea Level
\# Feet Below Ground Surface

WMU #5 (Slag Pit Sump)

TABLE 2B
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Diameter (inches)
121	451,767	556,106	4,485.6	106.0	96.0	118.5	120.0	89.1	4
108	452,317	556,574	4,482.4	97.6	91.0	110.1	150.0	87.3	4
122	452,470	556,282	4,475.9	101.5	90.0	113.0	121.5	80.6	4
123	452,221	557,000	4,484.1	106.5	99.0	118.5	121.2	88.8	4

* Determined in October 1997 and reported in RCRA Interim Status 1997 Groundwater Monitoring Assessment, February 1998.
^ Feet Above Mean Sea Level
\# Feet Below Ground Surface

WMU #7 (Pond 8S)

TABLE 2C
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Diameter (inches)
158	450,028	554,945	4,496.1	135.8	130.5	148.8	149.0	97.2	4
155	450,433	554,399	4,491.2	110.2	105.0	122.7	123.6	93.3	4
156	450,419	554,633	4,494.6	111.0	105.0	124.0	124.1	96.6	4
157	450,430	554,875	4,502.3	121.0	16.0	133.5	134.5	104.5	4
183	450,018	554,928	4,497	100.0	95.0	117.9	119.7	95.7**	4

- Determined in October 1997 and reported in RCRA Interim Status 1997 Groundwater Monitoring Assessment, February 1998.
- ** Based on well development field notes.

^ Feet Above Mean Sea Level
# Feet Below Ground Surface

WMUs #8 AND #11 (PHASE IV PONDS AND POND 8E)

TABLE 2D
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Diameter (inches)
104	450,146	554,270	4,487.0	96.5	88.0	109.0	110.0	87.0	4
131	450,212	553,743	4,486.2	153.9	147.0	165.6	167.0	87.3	4
114	449,849	553,030	4,470.8	116.7	112.0	129.0	141.5	71.0	4
167	449,404	554,015	4,492.6	116.5	113.5	139.0	139.0	91.4	4
168	450,082	553,286	4,474.3	75.5	71.0	93.0	93.5	74.4	4

* Determined in November 1996 and reported in RCRA Interim Status 1996 Groundwater Monitoring Assessment, February 1997.

^ Feet Above Mean Sea Level
# Feet Below Ground Surface

WMU #9 (Pond 9E)

TABLE 2E
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Dia-meter (inches)
124	450,362	552,029	4,448.4	72.6	66.5	84.8	85.0	50.2	4
113	449,982	552,482	4,463.0	82.2	77.0	94.5	97.0	63.3	4
126	451,663	552,430	4,556.0	75.5	69.0	88.0	90.0	56.3	4
127	451,068	552,687	4,458.2	77.0	72.0	89.3	90.5	58.9	4
128	450,494	552,684	4,461.9	84.3	79.5	96.5	97.0	62.4	4

* Determined in November 1997 and reported in RCRA Interim Status 1997 Groundwater Monitoring Assessment, February 1998.
^ Feet Above Mean Sea Level
\# Feet Below Ground Surface

WMU #10 (Pond 16S)

TABLE 2F
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Ground Elevation (FTMSL^)	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Diam-eter (inches)
147	450,623	550,769	4,442.3	4,444.1	70.7	65.0	83.2	83.5	42.8	4
148	450,479	551,188	4,445.0	4,446.5	67.1	60.0	79.6	80.0	45.5	4
149	450,047	551,254	4,446.3	4,447.3	69.3	64.0	81.8	88.5	47.0	4
154	449,702	550,198	4,445.3	4,447.0	73.6	68.0	81.1	83	44.8	4

* Determined in October 1997 and reported in RCRA Interim Status 1997 Groundwater Monitoring Assessment, February 1998.
^ Feet Above Mean Sea Level
\# Feet Below Ground Surface

WMU #14 (Pond 17)

TABLE 2G
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Diameter (inches)
171	449,597	551,237	4,452.4	76.5	69.0	89.0	89.0	53.4	4
172[a]	449,272	551,081	4,450.6	71.0	69.0	79.0	79.5	51.5	4
173[bc]	449,231	550,172	4,452.6	70.0	65.4	87.8	89.0	50.0	4
180[a]	449,088	550,976	4,452.8	52.2	48.7	65.2	65.5	53.5	4

* Determined in August 1997, except where noted.
^ Feet Above Mean Sea Level
# Feet Below Ground Surface
a - Data for well installed in July 1997.
b - This is a replacement well near Well 179, screened in the upper coarse-grained layer of the uppermost aquifer.
c - Data for well installed in October 1998.

WMU #15 (Pond 18 Cell A)

TABLE 2H
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft#)*	Well Diameter (inches)
154[a]	449,702	550,198	4,447	73.6	68.0	81.1	83.0	50.0	4
174	449,233	549,303	4,446.9	75.0	70.1	87.9	88.0	50.0	4
177	450,022	550,106	4,444.6	75.1	71.4	88.0	88.4	50.0	4
178	449,474	550,275	4,451.1	60.0	56.4	77.8	78.5	46.5	4

* Determined in October 1998, except where noted.
^ Feet Above Mean Sea Level
# Feet Below Ground Surface
a - Data for well installed in November 1992.

Note: Wells 175 and 176 will continue to be part of the Pond 18 groundwater monitoring program until Pond 18 is closed.

WMU #15 (Pond 18)

TABLE 2I
WELL CONSTRUCTION SUMMARY

Well ID	Northing	Easting	Top of Riser Casing Elevation (FTMSL^)	Depth to Screen (ft#)	Depth to Filter Pack (ft#)	Total Depth of Well (ft#)	Total Depth Explored (ft#)	Depth to Ground-water (ft##)*	Well Diameter (inches)
154	449,702	550,198	4,447.0	73.6	68.0	81.1	83	46.9	4
174	449,233	549,303	4,446.9	75.0	70.1	87.9	88	43.3	4
175	449,797	549,119	4,443.5	72.0	67.0	84.9	85	43.0	4
176	450,292	550,019	4,443.1	74.8	70.5	87.4	88	43.3	4
177	450,022	550,108	4,444.6	75.1	71.4	88.0	88.4	44.7	4
178	449,474	550,275	4,451.1	60.0	56.4	77.8	78.5	51.0	4

* Determined in November 1998 and reported in RCRA Interim Status 1998 Groundwater Monitoring Assessment, February 1999.
^ Feet Above Mean Sea Level
\# Feet Below Ground Surface
\## Feet Below Top of Riser Casing Elevation

Note: Wells 175 and 176 will continue to be part of the Pond 18 groundwater monitoring program until Pond 18 is closed.

WMU # 3 (POND 15S)

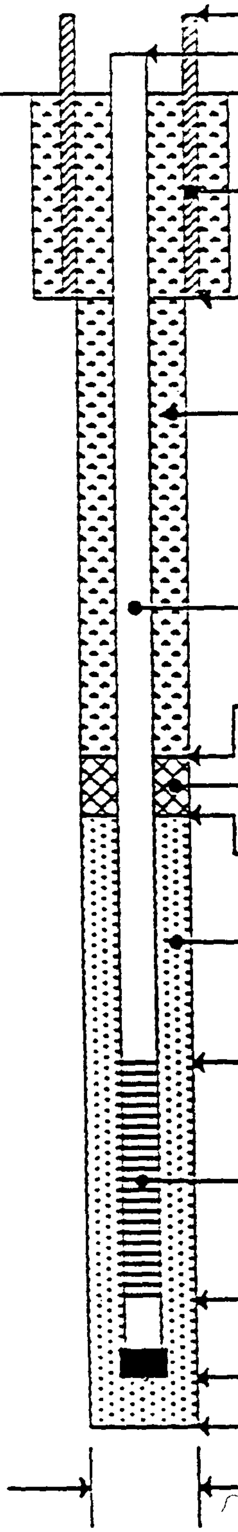
WELL COMPLETION DIAGRAMS

MONITORING WELL	PROJECT: EMF POCATELLO, ID		WELL NO.: 113
JOB NO.: 21372	SITE: North of Pond 15S	COORDINATES and/or STATIONINGS: N 449,982.1 E 552,482.1	
BEGUN: 10-15-90 / COMPLETED: 10-16-90	PREPARED BY: Garrett Day	REFERENCE POINT FOR MEASUREMENTS: Top of PVC casing(Water level)	

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.1	4463.3
TOP OF RISER CASING	1.8	4463.0
GROUND SURFACE	0.0	4461.2
BOTTOM OF SURFACE CASING	2.9	4458.2
TOP OF SEAL	73.0	4388.2
TOP OF FILTER PACK	77.0	4384.2
TOP OF SCREEN	82.2	4379.0
BOTTOM OF SCREEN	91.7	4369.5
BOTTOM OF SUMP	94.5	4366.7
BOTTOM OF HOLE	97.0	4364.2

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 8-12-92
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	115

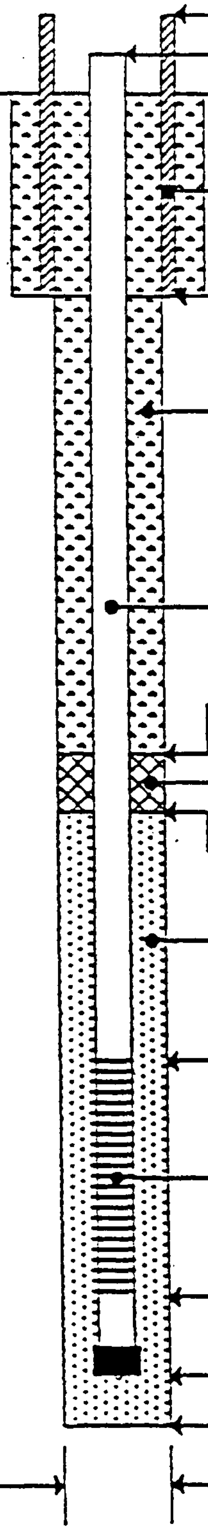
JOB NO.	SITE	COORDINATES and/or STATIONINGS
21372	Northeast of Pond 15S	N 449,999.6 E 552,938.2

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
[illegible]-15-90	10-15-90	Curtis Obi	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.2	4469.9
TOP OF RISER CASING	2.0	4469.7
GROUND SURFACE	0.0	4467.7
BOTTOM OF SURFACE CASING	2.8	4464.9
TOP OF SEAL	105.0	4362.7
TOP OF FILTER PACK	109.0	4358.7
TOP OF SCREEN	118.5	4349.2
BOTTOM OF SCREEN	128.5	4339.2
BOTTOM OF SUMP	131.0	4336.7
BOTTOM OF HOLE	140.0	4327.7

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 8-12-92
Template: ZWELLOG

NOT TO SCALE

MONITORING WELL

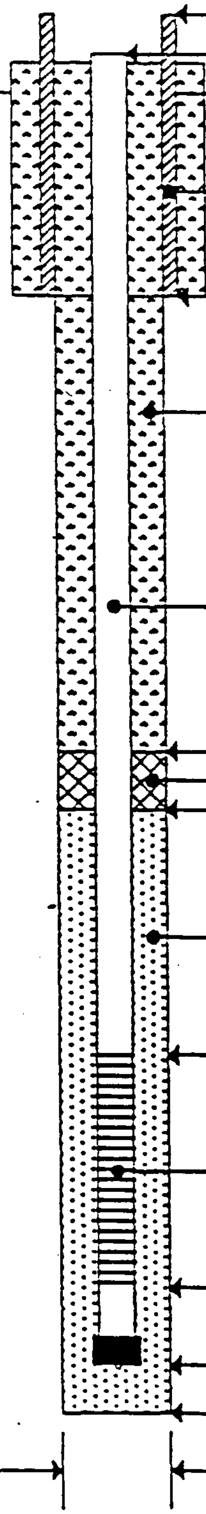
PROJECT	WELL NO.
EMF POCATELLO, ID	165

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 449,237 E 551,986

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
8-25-95	8-25-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.9	4464.6
TOP OF RISER CASING	2.5	4464.2
GROUND SURFACE	0.0	4461.7
BOTTOM OF SURFACE CASING	2.1	4459.6
TOP OF SEAL	70.7	4391.0
TOP OF FILTER PACK	80.7	4381.0
TOP OF SCREEN	85.0	4376.7
BOTTOM OF SCREEN	95.0	4366.7
BOTTOM OF SUMP	97.0	4364.7
BOTTOM OF HOLE	97.2	4364.5

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 10-19-95
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

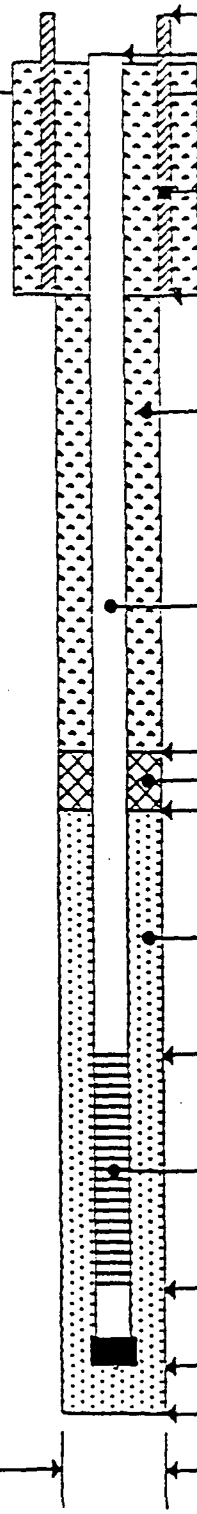
PROJECT	WELL NO.
EMF POCATELLO, ID	166

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 450,004 E 552,802

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
8-27-95	8-27-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.7	4468.1
TOP OF RISER CASING	2.0	4467.4
GROUND SURFACE	0.0	4465.4
BOTTOM OF SURFACE CASING	2.3	4463.1
TOP OF SEAL	72.0	4393.4
TOP OF FILTER PACK	82.0	4383.4
TOP OF SCREEN	85.5	4379.9
BOTTOM OF SCREEN	95.5	4369.9
BOTTOM OF SUMP	98.0	4367.4
BOTTOM OF HOLE	99.0	4366.4

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 10-19-95
Template: 2WELLOG

NOT TO SCALE

WMU # 5 (SLAG PIT SUMP)

WELL COMPLETION DIAGRAMS

MONITORING WELL	PROJECT	WELL NO.
	EMF POCATELLO, ID	108

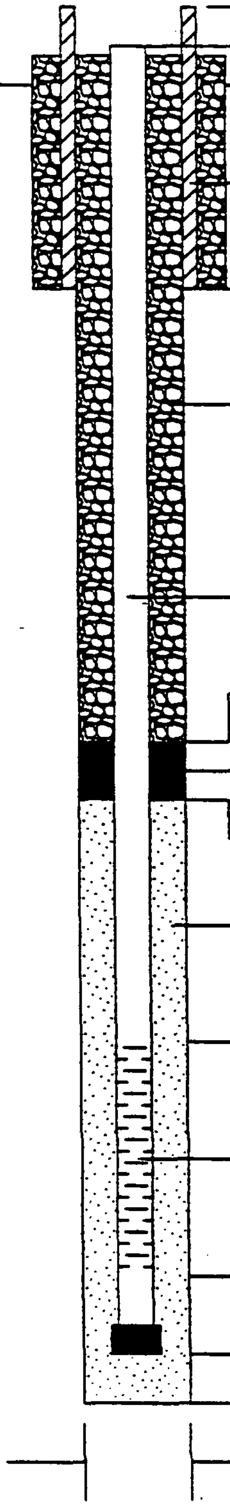
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	Northeast of Slag Pit Sump	N 452,316.5 : E 556,573.7

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-12-90	10-12-90	Curtis Obi	Top of PVC casing (water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.3	4482.55
TOP OF RISER CASING	-2.1	4482.4
GROUND SURFACE	0.0	4480.3
SURFACE CASING DIAMETER: 8" TYPE: Steel with locking lid		
BOTTOM OF SURFACE CASING	2.7	4477.6
BACKFILL MATERIAL TYPE Cement - Bentonite Grout		
RISER CASING DIAMETER: 4" TYPE: Schedule 40 PVC		
TOP OF SEAL	87.0	4393.3
ANNULAR SEAL TYPE Bentonite Slurry		
TOP OF FILTER PACK	91.0	4389.3
FILTER PACK TYPE Silica sand 10-20 & 20-40		
TOP OF SCREEN	97.6	4382.7
SCREEN DIAMETER: 4" TYPE: Sch. 40 PVC/Machine Cut OPENING WIDTH: 0.020" TYPE:		
BOTTOM OF SCREEN	107.6	4372.7
BOTTOM OF SUMP	110.1	4370.2
BOTTOM OF HOLE	150.0	4330.3
HOLE DIAMETER: 10-inches		

Update: Apr 22, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	121

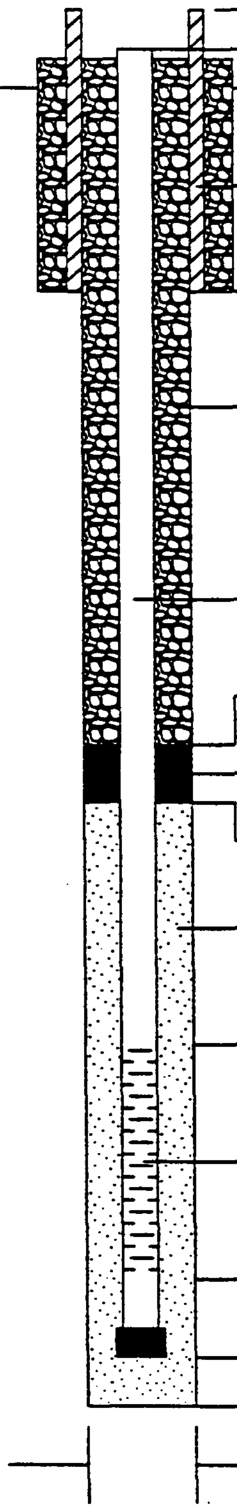
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	Southwest of Slag Pit Sump	N 451,766.8 : E 556,105.7

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-10-90	10-10-90	Curtis Obi	Top of PVC casing (water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.3	4485.76
TOP OF RISER CASING	-2.1	4485.58
GROUND SURFACE	0.0	4483.5
BOTTOM OF SURFACE CASING	2.7	4480.8
TOP OF SEAL	92.0	4391.5
TOP OF FILTER PACK	96.0	4387.5
TOP OF SCREEN	106.0	4377.5
BOTTOM OF SCREEN	116.0	4367.5
BOTTOM OF SUMP	118.5	4365.0
BOTTOM OF HOLE	120.0	4363.5

SURFACE CASING
DIAMETER: 8"
TYPE: Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Apr 22, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	122

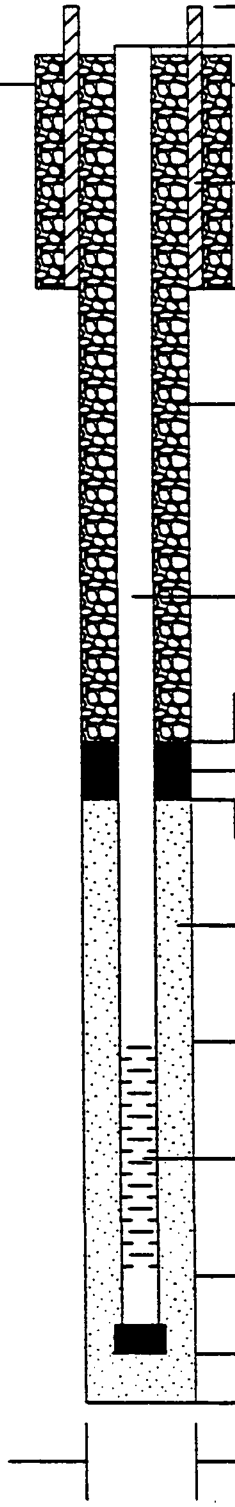
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	North of Slag Pit Sump	N 452,470.2 : E 556,282.4

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-11-90	10-11-90	Curtis Obi	Top of PVC casing (water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.2	4476.1
TOP OF RISER CASING	-2.0	4475.92
GROUND SURFACE	0.0	4473.9
BOTTOM OF SURFACE CASING	2.8	4471.1
TOP OF SEAL	86.0	4387.9
TOP OF FILTER PACK	90.0	4383.9
TOP OF SCREEN	101.5	4372.4
BOTTOM OF SCREEN	111.5	4362.4
BOTTOM OF SUMP	113.0	4360.9
BOTTOM OF HOLE	121.5	4352.4

SURFACE CASING
DIAMETER: 8"
TYPE: Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Apr 22, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	123

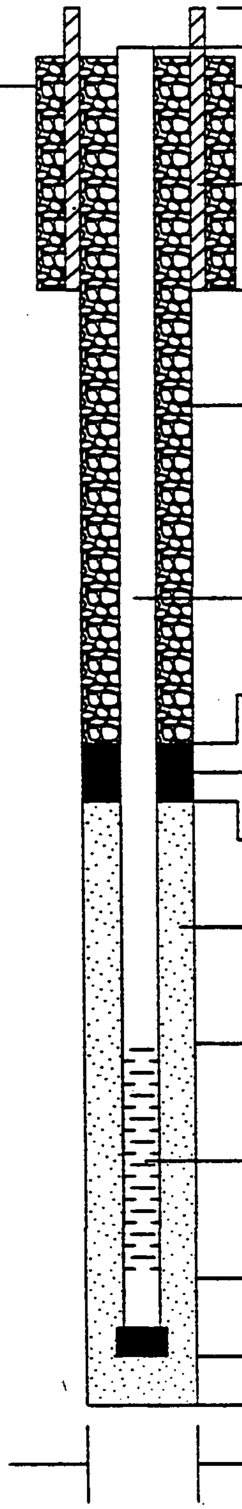
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	Northeast of Slag Pit Sump	N 452,221.3 : E 557,000.1

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-13-90	10-13-90	Curtis Obi	Top of PVC casing (water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.3	4484.29
TOP OF RISER CASING	-2.1	4484.12
GROUND SURFACE	0.0	4482.0
BOTTOM OF SURFACE CASING	2.7	4479.3
TOP OF SEAL	95.0	4387.0
TOP OF FILTER PACK	99.0	4383.0
TOP OF SCREEN	106.5	4375.5
BOTTOM OF SCREEN	116.0	4366.0
BOTTOM OF SUMP	118.5	4363.5
BOTTOM OF HOLE	121.2	4360.8

SURFACE CASING
DIAMETER: 8"
TYPE: Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Apr 22, 1996
Report Form: EMF-WELLOG2

NOT TO SCALE

WMU # 7 (POND 8S)

WELL COMPLETION DIAGRAMS

MONITORING WELL

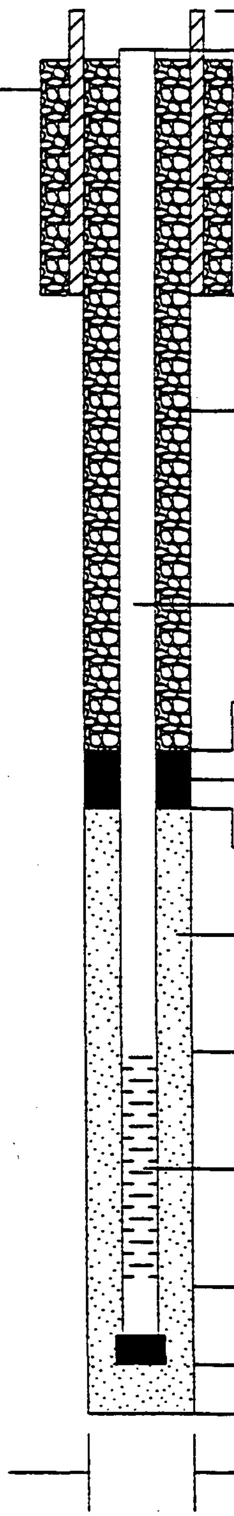
PROJECT	WELL NO.
EMF POCATELLO, ID	155

JOB NO.	SITE	COORDINATES and / or STATIONING
[illegible]0906	FMC Corporation	N 450,432.7 : E 554,398.5

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
9-6-95	9-6-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3.1	4492.1
TOP OF RISER CASING	-2.2	4491.21
GROUND SURFACE	0.0	4489.0
BOTTOM OF SURFACE CASING	1.9	4487.1
TOP OF SEAL	95.0	4394.0
TOP OF FILTER PACK	105.0	4384.0
TOP OF SCREEN	110.2	4378.8
BOTTOM OF SCREEN	120.2	4368.8
BOTTOM OF SUMP	122.7	4366.3
BOTTOM OF HOLE	123.6	4365.4

SURFACE CASING
DIAMETER: 8"
TYPE: Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Oct 13, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

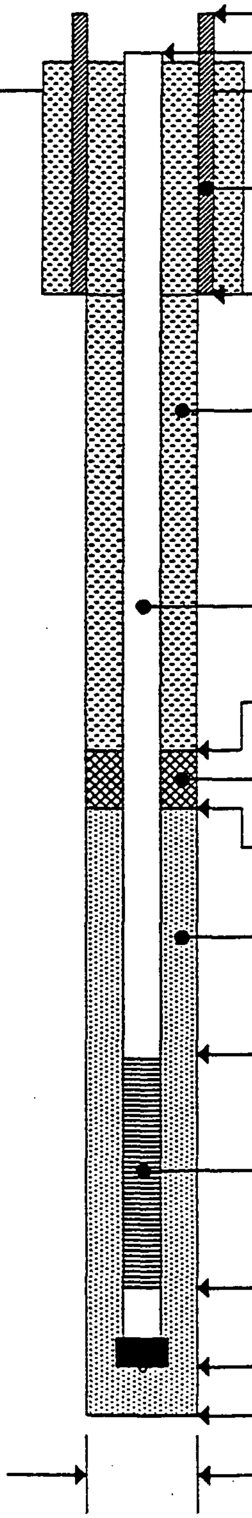
MONITORING WELL	PROJECT: *EMF POCATELLO, ID*	WELL NO.: 156

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 450,419 E 554,633

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
9-9-95	9-9-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.9	4495.0
TOP OF RISER CASING	2.5	4494.6
GROUND SURFACE	0.0	4492.1
BOTTOM OF SURFACE CASING	2.1	4490.0
TOP OF SEAL	95.0	4397.1
TOP OF FILTER PACK	105.0	4387.1
TOP OF SCREEN	111.0	4381.1
BOTTOM OF SCREEN	121.0	4371.1
BOTTOM OF SUMP	124.0	4368.1
BOTTOM OF HOLE	124.1	4368.0

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Brady 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 10-19-95
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

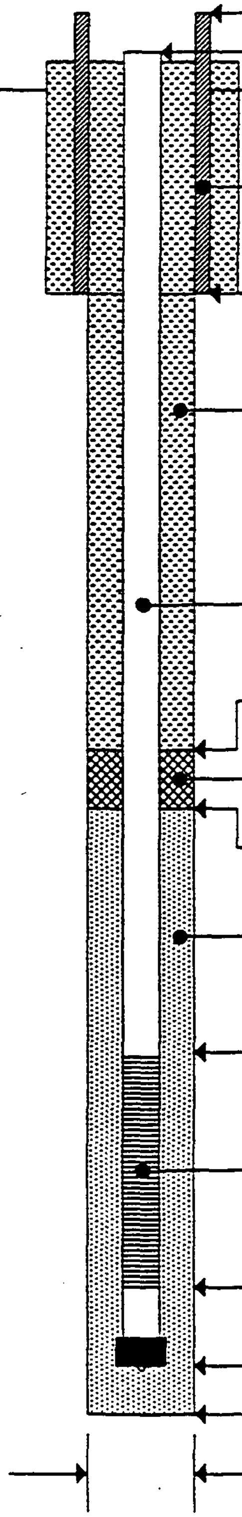
PROJECT	WELL NO.
EMF POCATELLO, ID	157

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 450,430 E 554,874

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
9-7-95	9-8-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.8	4503.0
TOP OF RISER CASING	2.1	4502.3
GROUND SURFACE	0.0	4500.2
BOTTOM OF SURFACE CASING	2.2	4498.0
TOP OF SEAL	106.0	4394.2
TOP OF FILTER PACK	116.0	4384.2
TOP OF SCREEN	121.0	4379.2
BOTTOM OF SCREEN	131.0	4369.2
BOTTOM OF SUMP	133.5	4366.7
BOTTOM OF HOLE	134.5	4365.7

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI & Brady 16-30 Silica

SCREEN
DIAMETER: 4"
TYPE: **Schedule 40 PVC machine-cut**
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 10-19-95
Template: 2WELLOG

NOT TO SCALE

BECHTEL MONITORING WELL

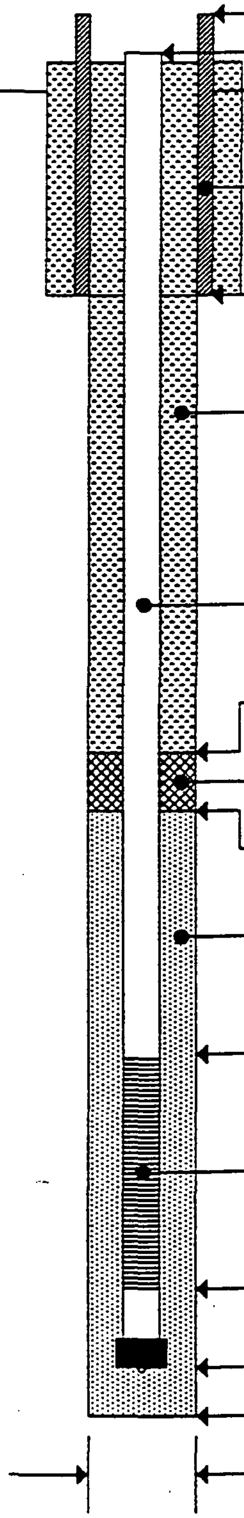
PROJECT	WELL NO.
EMF POCATELLO, ID	158

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 450,028 E 554,945

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
6-23-93	6-24-93	Dave Kyllonen	Top of PVC - Water levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.9	4496.9
TOP OF RISER CASING	2.1	4496.1
GROUND SURFACE	0.0	4494.0
BOTTOM OF SURFACE CASING	2.1	4491.9
TOP OF SEAL	120.0	4374.0
TOP OF FILTER PACK	130.5	4363.5
TOP OF SCREEN	135.8	4358.2
BOTTOM OF SCREEN	145.8	4348.2
BOTTOM OF SUMP	148.8	4345.2
BOTTOM OF HOLE	149.0	4345.0

SURFACE CASING
DIAMETER/TYPE: 8 5/8"/ Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 10-20 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC Slotted
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 9-8-93
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	183

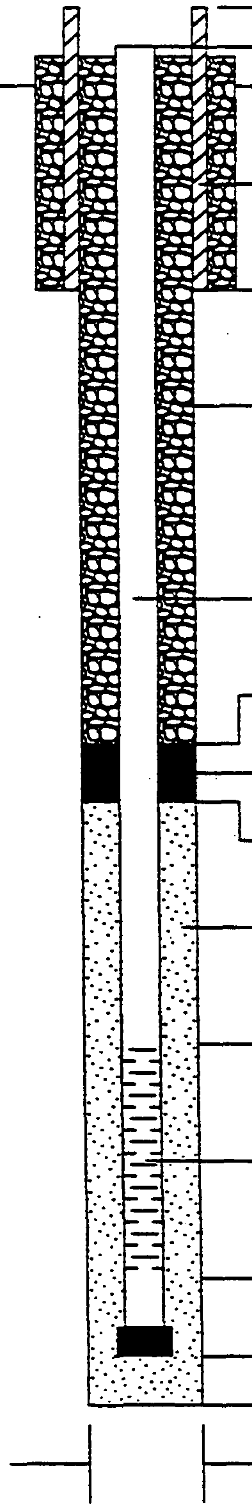
JOB NO.	SITE	COORDINATES and / or STATIONING
06	FMC Pond 8S	N 450,017.7 : E 554,927.8

BE	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-17-98	10-17-98	L. R. West	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4497.33
TOP OF RISER CASING	-2.8	4497.13
GROUND SURFACE	0.0	4494.3
BOTTOM OF SURFACE CASING	2.0	4492.3
TOP OF SEAL	85.0	4409.3
TOP OF FILTER PACK	95.0	4399.3
TOP OF SCREEN	100.0	4394.3
BOTTOM OF SCREEN	115.0	4379.3
BOTTOM OF SUMP	117.9	4376.5
BOTTOM OF HOLE	119.7	4374.6

SURFACE CASING
DIAMETER: 8-5/8 inch OD
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
10-20 CSSI Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC
OPENING WIDTH: 0.020"
TYPE: Machine-cut

HOLE DIAMETER: 9 5/8-inches

Update: Nov 12, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

WMUs # 8 and #11

(PHASE IV PONDS and POND 8E)

WELL COMPLETION DIAGRAMS

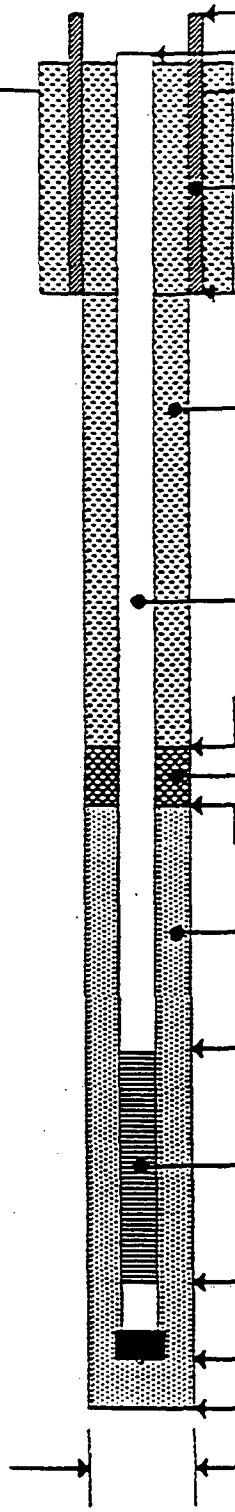
MONITORING WELL	PROJECT: EMF POCATELLO, ID		WELL NO.: 104
JOB NO.: 21372	SITE: NE of Ponds 8E and 11S-14S	COORDINATES and/or STATIONING: N 450,146 E 554,270	
BEGUN: 11-7-90	COMPLETED: 11-7-90	PREPARED BY: Curtis Obi	REFERENCE POINT FOR MEASUREMENTS: Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

Plugged on: 11-6-90

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.4	4487.0
TOP OF RISER CASING	2.1	4486.7
GROUND SURFACE	0.0	4484.6
BOTTOM OF SURFACE CASING	2.6	4482.0
TOP OF SEAL	84.0	4400.6
TOP OF FILTER PACK	88.0	4396.6
TOP OF SCREEN	96.5	4388.1
BOTTOM OF SCREEN	106.5	4378.1
BOTTOM OF SUMP	109.0	4375.6
BOTTOM OF HOLE	110.0	4374.6

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 8-12-92
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	114

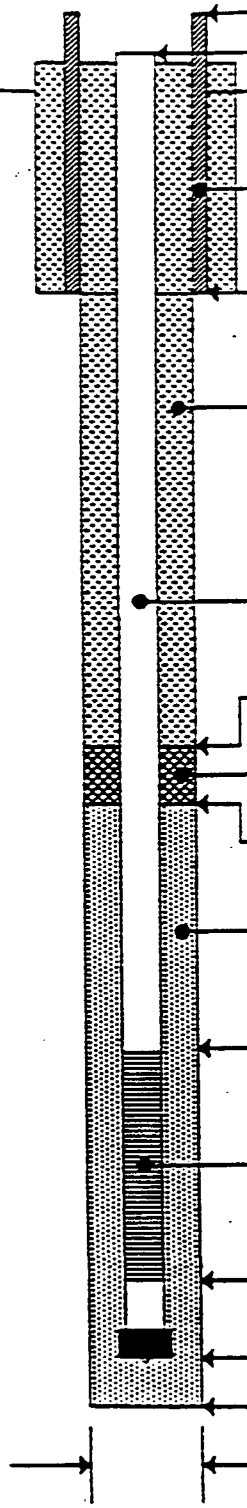
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	Northeast of Pond 15S	N 449,849 E 553,030

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-16-90	10-17-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.2	4470.8
TOP OF RISER CASING	2.0	4470.6
GROUND SURFACE	0.0	4468.6
BOTTOM OF SURFACE CASING	2.8	4465.8
TOP OF SEAL	108.0	4360.6
TOP OF FILTER PACK	112.0	4356.6
TOP OF SCREEN	116.7	4351.9
BOTTOM OF SCREEN	126.2	4342.4
BOTTOM OF SUMP	129.0	4339.6
BOTTOM OF HOLE	141.5	4327.1

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 11-10-93
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	131

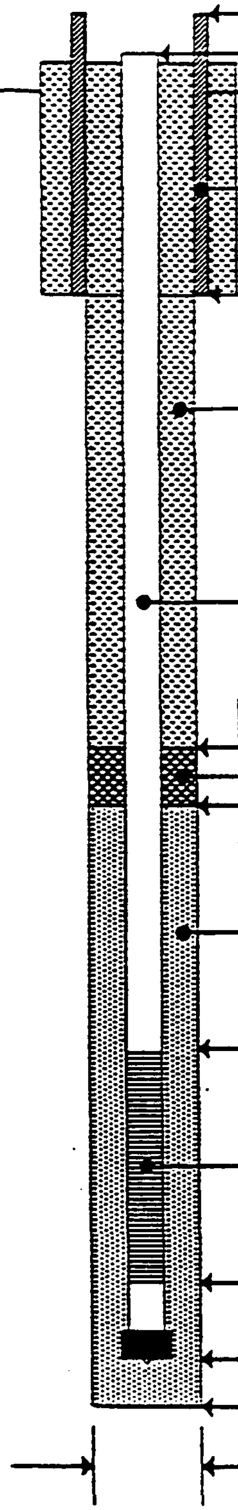
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	N of Ponds 8E and 11S-14S	N 450,212 E 553,743

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-23-90	10-23-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	1.7	4486.2
TOP OF RISER CASING	1.4	4485.9
GROUND SURFACE	0.0	4484.5
BOTTOM OF SURFACE CASING	3.3	4481.2
TOP OF SEAL	143.0	4341.5
TOP OF FILTER PACK	147.0	4337.5
TOP OF SCREEN	153.9	4330.6
BOTTOM OF SCREEN	163.9	4320.6
BOTTOM OF SUMP	165.6	4318.9
BOTTOM OF HOLE	167.0	4317.5

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 80 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 80 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 11-10-93
Template: ZWELLOG

NOT TO SCALE

MONITORING WELL

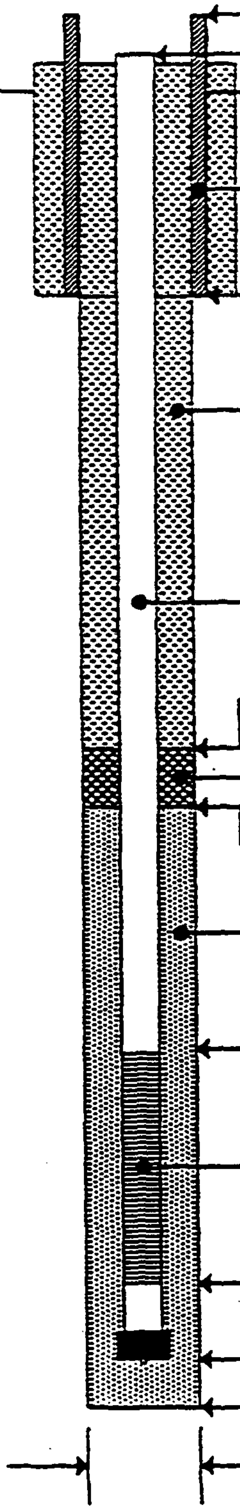
PROJECT	WELL NO.
EMF POCATELLO, ID	167

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 449,404 E 554,016

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
8-23-95	8-24-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.5	4492.6
TOP OF RISER CASING	2.1	4492.2
GROUND SURFACE	0.0	4490.1
BOTTOM OF SURFACE CASING	2.5	4487.6
TOP OF SEAL	103.5	4386.6
TOP OF FILTER PACK	113.5	4376.6
TOP OF SCREEN	116.5	4373.6
BOTTOM OF SCREEN	136.5	4353.6
BOTTOM OF SUMP	139.0	4351.1
BOTTOM OF HOLE	139.0	4351.1

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 10-19-95
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

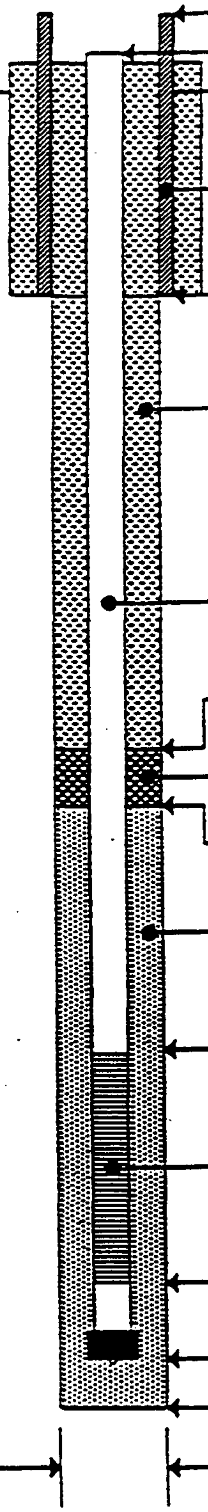
PROJECT	WELL NO.
EMF POCATELLO, ID	168

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 450,082 E 553,286

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
8-30-95	8-30-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.7	4474.3
TOP OF RISER CASING	2.3	4473.9
GROUND SURFACE	0.0	4471.6
BOTTOM OF SURFACE CASING	2.3	4469.3
TOP OF SEAL	61.0	4410.6
TOP OF FILTER PACK	71.0	4400.6
TOP OF SCREEN	75.5	4396.1
BOTTOM OF SCREEN	90.5	4381.1
BOTTOM OF SUMP	93.0	4378.6
BOTTOM OF HOLE	93.5	4378.1

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 10-19-95
Template: ZWELLOG

NOT TO SCALE

WMU # 9 (POND 9E)

WELL COMPLETION DIAGRAMS

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	113

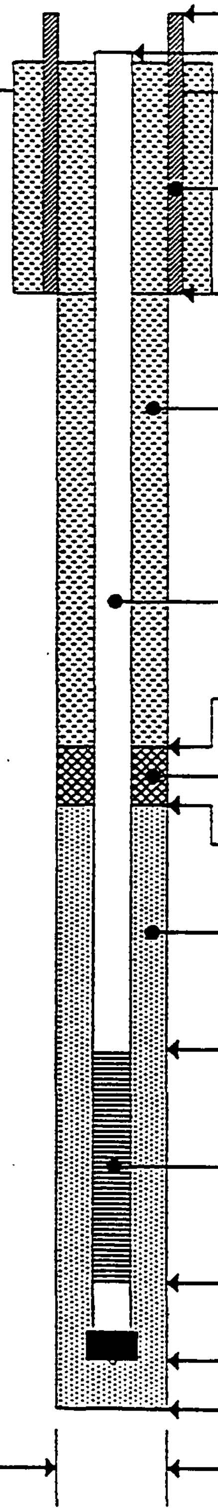
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	North of Pond 15S	N 449,982 E 552,482

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-15-90	10-16-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.1	4463.3
TOP OF RISER CASING	1.8	4463.0
GROUND SURFACE	0.0	4461.2
BOTTOM OF SURFACE CASING	2.9	4458.2
TOP OF SEAL	73.0	4388.2
TOP OF FILTER PACK	77.0	4384.2
TOP OF SCREEN	82.2	4379.0
BOTTOM OF SCREEN	91.7	4369.5
BOTTOM OF SUMP	94.5	4366.7
BOTTOM OF HOLE	97.0	4364.2

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 11-10-93
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	124

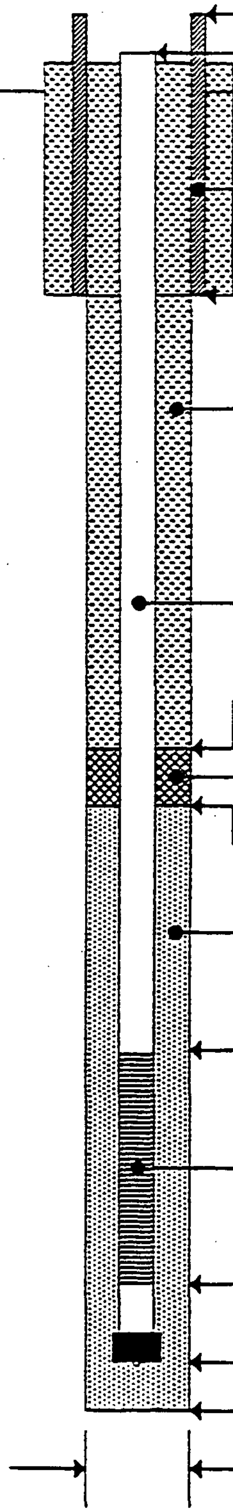
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	West of Pond 9E	N 450,362 E 552,029

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-22-90	10-22-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.1	4448.7
TOP OF RISER CASING	1.8	4448.4
GROUND SURFACE	0.0	4446.6
BOTTOM OF SURFACE CASING	2.9	4443.7
TOP OF SEAL	62.5	4384.1
TOP OF FILTER PACK	66.5	4380.1
TOP OF SCREEN	72.6	4374.0
BOTTOM OF SCREEN	82.1	4364.5
BOTTOM OF SUMP	84.8	4361.8
BOTTOM OF HOLE	85.0	4361.6

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 8-12-92
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	126

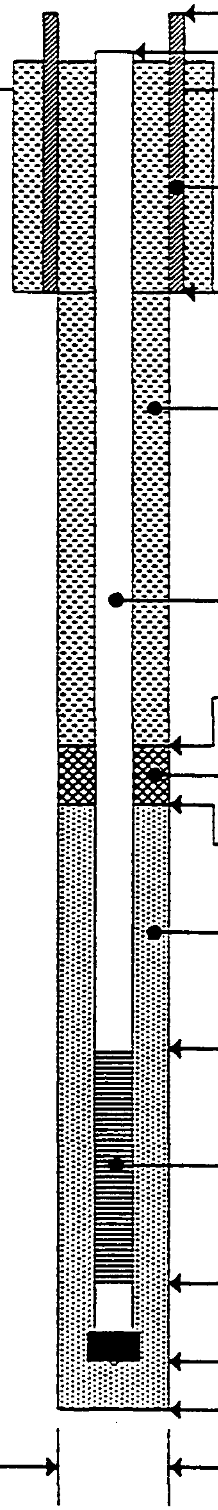
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	North of Pond 9E	N 451,223 E 552,430

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-16-90	10-17-90	Curtis Obi	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.2	4456.2
TOP OF RISER CASING	2.0	4556.0
GROUND SURFACE	0.0	4454.0
SURFACE CASING DIAMETER/TYPE: 8"/ Steel with locking lid		
BOTTOM OF SURFACE CASING	2.8	4451.2
BACKFILL MATERIAL TYPE Cement - Bentonite Grout		
RISER CASING DIAMETER/TYPE: 4"/Schedule 40 PVC		
TOP OF SEAL	65.0	4389.0
ANNULAR SEAL TYPE Bentonite Slurry		
TOP OF FILTER PACK	69.0	4385.0
FILTER PACK TYPE Silica sand 10-20 & 20-40		
TOP OF SCREEN	75.5	4378.5
SCREEN DIAMETER: 4" TYPE: Sch. 40 PVC/Machine Cut OPENING WIDTH: 0.020"		
BOTTOM OF SCREEN	85.5	4368.5
BOTTOM OF SUMP	88.0	4366.0
BOTTOM OF HOLE	90.0	4364.0

HOLE DIAMETER: 10"

Update: 8-12-92
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO. ID	127

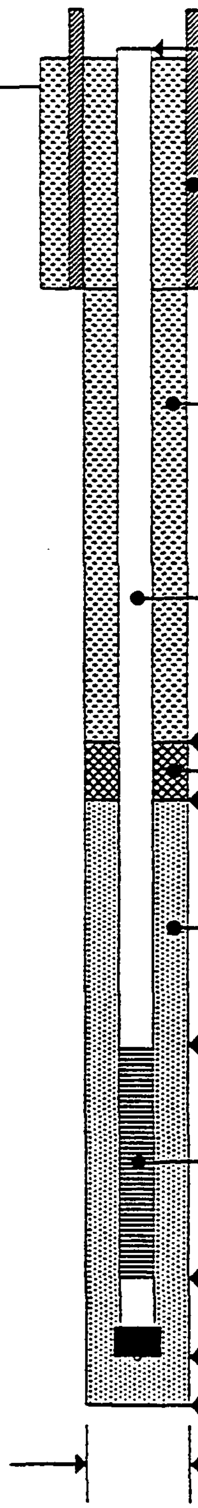
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	Northeast of Pond 9E	N 451,068 E 552,687

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-13-90	10-13-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.1	4458.5
TOP OF RISER CASING	1.8	4458.2
GROUND SURFACE	0.0	4456.4
SURFACE CASING — DIAMETER/TYPE: 8"/ Steel with locking lid		
BOTTOM OF SURFACE CASING	2.9	4453.5
BACKFILL MATERIAL TYPE: Cement - Bentonite Grout		
RISER CASING — DIAMETER/TYPE: 4"/Schedule 40 PVC		
TOP OF SEAL	68.0	4388.0
ANNULAR SEAL TYPE: Bentonite Slurry		
TOP OF FILTER PACK	72.0	4384.0
FILTER PACK TYPE: Silica sand 10-20 & 20-40		
TOP OF SCREEN	77.0	4379.4
SCREEN — DIAMETER: 4" TYPE: Sch. 40 PVC/Machine Cut OPENING WIDTH: 0.020"		
BOTTOM OF SCREEN	86.5	4369.9
BOTTOM OF SUMP	89.3	4367.1
BOTTOM OF HOLE	90.5	4365.9
HOLE DIAMETER: 10"		

Update: 8-12-92
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	128

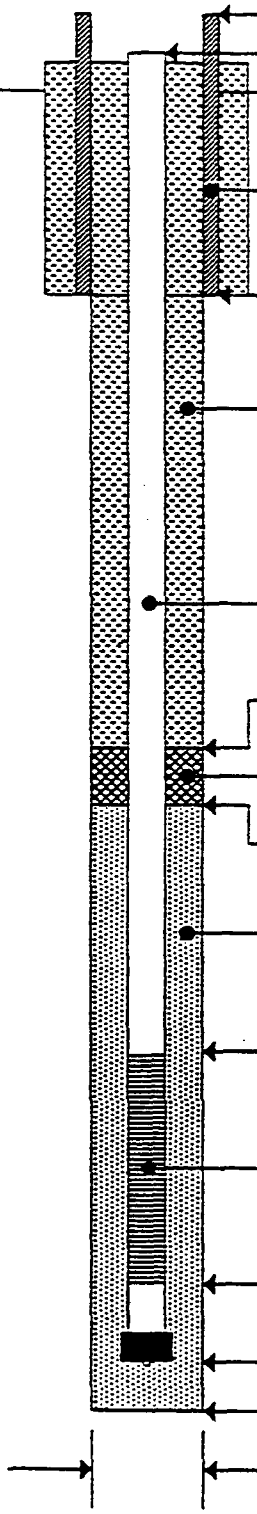
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	East of Pond 9E	N 450,494 E 552,684

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-14-90	10-15-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.1	4462.1
TOP OF RISER CASING	1.9	4461.9
GROUND SURFACE	0.0	4460.0
BOTTOM OF SURFACE CASING	2.9	4457.1
TOP OF SEAL	75.0	4384.5
TOP OF FILTER PACK	79.5	4380.5
TOP OF SCREEN	84.3	4375.7
BOTTOM OF SCREEN	93.8	4366.2
BOTTOM OF SUMP	96.5	4363.5
BOTTOM OF HOLE	97.0	4363.0

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 8-12-92
Template: 2WELLOG

NOT TO SCALE

WMU # 10 (POND 16S)

WELL COMPLETION DIAGRAMS

MONITORING WELL

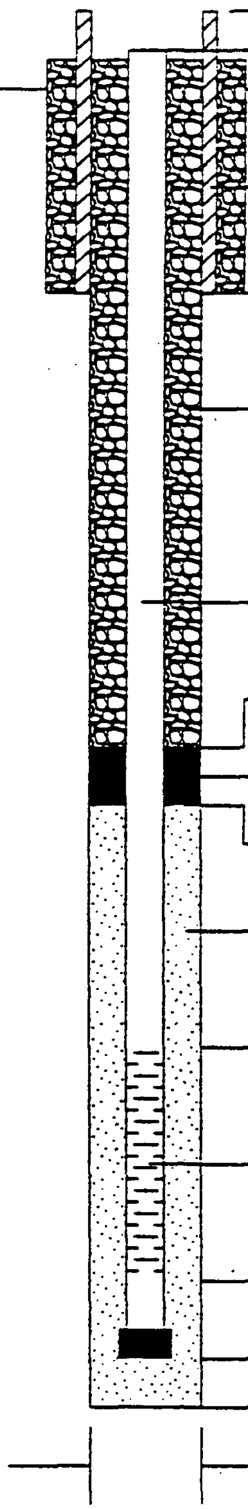
PROJECT	WELL NO.
EMF POCATELLO, ID	147

JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Corporation	N 450,622.8 : E 550,769.3

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
5-10-92	5-10-92	Garrett Day	Top of PVC Casing-Water Level

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-1.8	~~4444.1~~
TOP OF RISER CASING	-1.4	~~4443.7~~
GROUND SURFACE	0.0	~~4442.3~~
SURFACE CASING DIAMETER: 8 1/2" TYPE: Steel with Locking Lid		
BOTTOM OF SURFACE CASING	3.2	4439.1
BACKFILL MATERIAL TYPE Cement-Bentonite Grout		
RISER CASING DIAMETER: 4" TYPE: Schedule 40 PVC		
TOP OF SEAL	60.0	4382.3
ANNULAR SEAL TYPE Bentonite Slurry / Fine Sand		
TOP OF FILTER PACK	65.0	4377.3
FILTER PACK TYPE CSSI 10-20 Sand		
TOP OF SCREEN	70.7	4371.6
SCREEN DIAMETER: 4" TYPE: Schedule 40 PVC OPENING WIDTH: 0.020" TYPE:		
BOTTOM OF SCREEN	79.7	4362.6
BOTTOM OF SUMP	83.2	4359.1
BOTTOM OF HOLE	83.5	4358.8

HOLE DIAMETER: 10-inches

Update: Oct 07, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

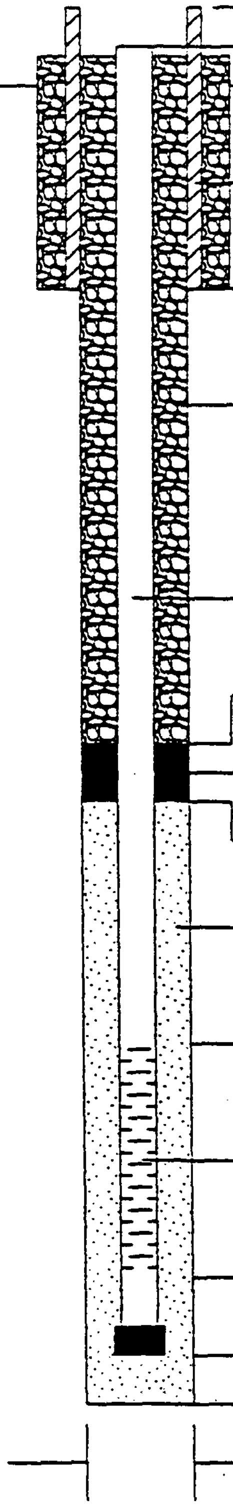
PROJECT			WELL NO.
EMF POCATELLO, ID			148

JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Corporation	N 450,479.4 : E 551,187.8

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
5-12-92	5-12-92	Garrett Day	Top of PVC Casing-Water Level

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-1.7	4446.7
TOP OF RISER CASING	-1.5	4446.5
GROUND SURFACE	0.0	4445.0
SURFACE CASING DIAMETER: 8 1/2" TYPE: Steel with Locking Lid		
BOTTOM OF SURFACE CASING	3.3	4441.7
BACKFILL MATERIAL TYPE Cement-Bentonite Grout		
RISER CASING DIAMETER: 4" TYPE: Schedule 40 PVC		
TOP OF SEAL	55.0	4390.0
ANNULAR SEAL TYPE Bentonite Slurry / Fine Sand		
TOP OF FILTER PACK	60.0	4385.0
FILTER PACK TYPE CSSI 10-20 Sand		
TOP OF SCREEN	67.1	4377.9
SCREEN DIAMETER: 4" TYPE: Schedule 40 PVC OPENING WIDTH: 0.020" TYPE:		
BOTTOM OF SCREEN	76.1	4368.9
BOTTOM OF SUMP	79.6	4365.4
BOTTOM OF HOLE	80.0	4365.0
HOLE DIAMETER: 10-inches		

Update: Oct 07, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

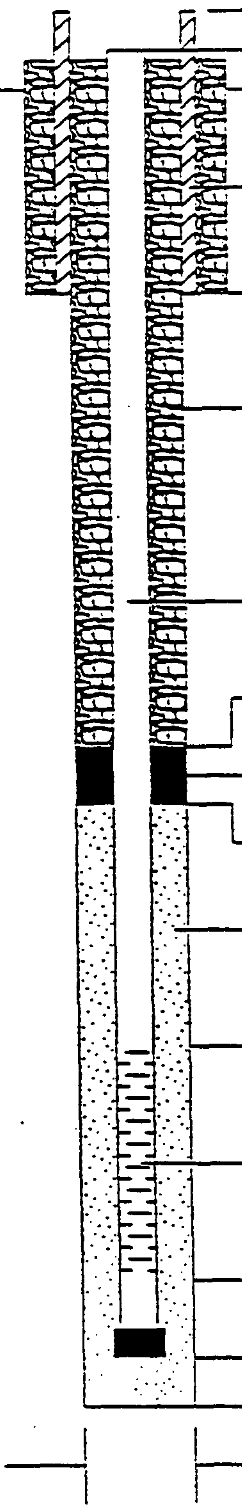
PROJECT	WELL NO.
EMF POCATELLO, ID	149

JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Corporation	N 450,047.3 : E 551,254.4

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
5-11-92	5-11-92	H. Feng	Top of PVC Casing-Water Level

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-1.8	4448.1
TOP OF RISER CASING	-1.0	4447.3
GROUND SURFACE	0.0	4446.3
BOTTOM OF SURFACE CASING	3.2	4443.1
TOP OF SEAL	59.0	4387.3
TOP OF FILTER PACK	64.0	4382.3
TOP OF SCREEN	69.3	4377.0
BOTTOM OF SCREEN	78.3	4368.0
BOTTOM OF SUMP	81.8	4364.5
BOTTOM OF HOLE	88.5	4357.8

SURFACE CASING
DIAMETER: 8 1/2"
TYPE: Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry / Fine Sand

FILTER PACK TYPE
CSSI 10-20 Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Oct 13, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

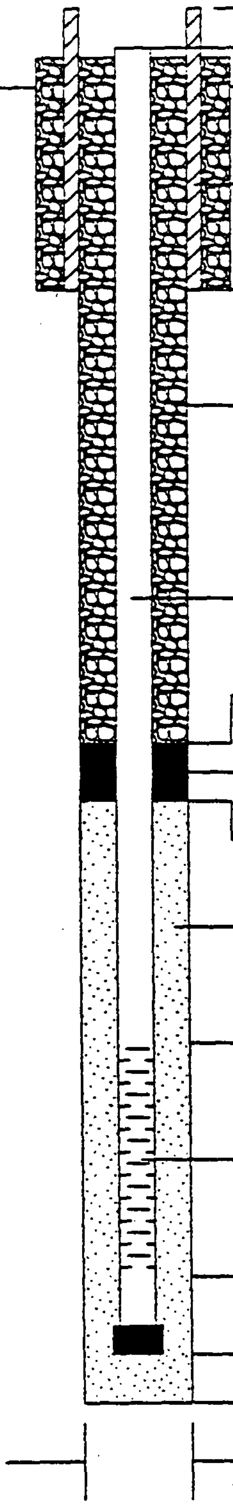
MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	154

JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Corporation	N 449,702.0 : E 550,197.8

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
11-2-92	11-2-92	G. Day	Top of PVC Casing-Water Level

(GENERALIZED GEOLOGIC LOG)



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.3	4447.6
TOP OF RISER CASING	-1.7	4447
GROUND SURFACE	0.0	4445.3
BOTTOM OF SURFACE CASING	2.7	4442.6
TOP OF SEAL	63.0	4382.3
TOP OF FILTER PACK	68.0	4377.3
TOP OF SCREEN	73.6	4371.7
BOTTOM OF SCREEN	77.8	4367.5
BOTTOM OF SUMP	81.1	4364.2
BOTTOM OF HOLE	83.0	4362.3

SURFACE CASING
DIAMETER: 8 1/2"
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry- 16-40 Sand

FILTER PACK TYPE
CSSI 10 X 20 Sand

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC / Machine cut
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Oct 07, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

WMU # 14 (POND 17)

WELL COMPLETION DIAGRAMS

MONITORING WELL

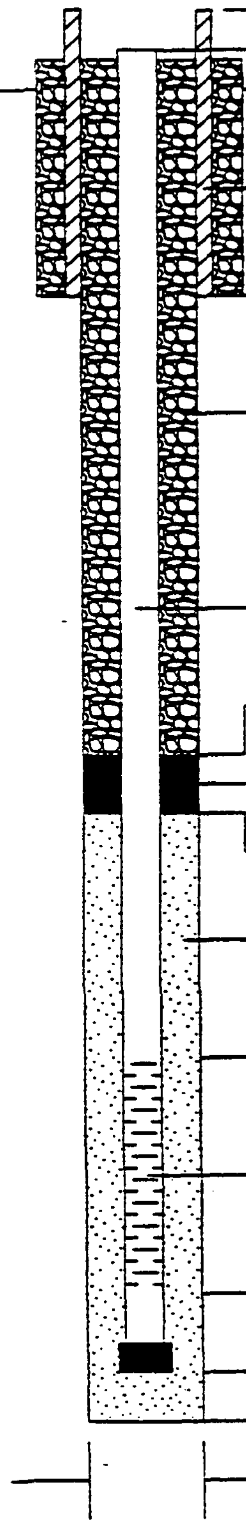
PROJECT	WELL NO.
EMF POCATELLO, ID	171

JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Corporation	N 449,596.5 : E 551,237.2

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
9-6-95	9-6-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.8	4452.7
TOP OF RISER CASING	-2.5	4452.41
GROUND SURFACE	0.0	4449.9
BOTTOM OF SURFACE CASING	2.2	4447.7
TOP OF SEAL	59.0	4390.9
TOP OF FILTER PACK	69.0	4380.9
TOP OF SCREEN	76.5	4373.4
BOTTOM OF SCREEN	86.5	4363.4
BOTTOM OF SUMP	89.0	4360.9
BOTTOM OF HOLE	89.0	4360.9

SURFACE CASING
DIAMETER: 8"
TYPE: Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Oct 13, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

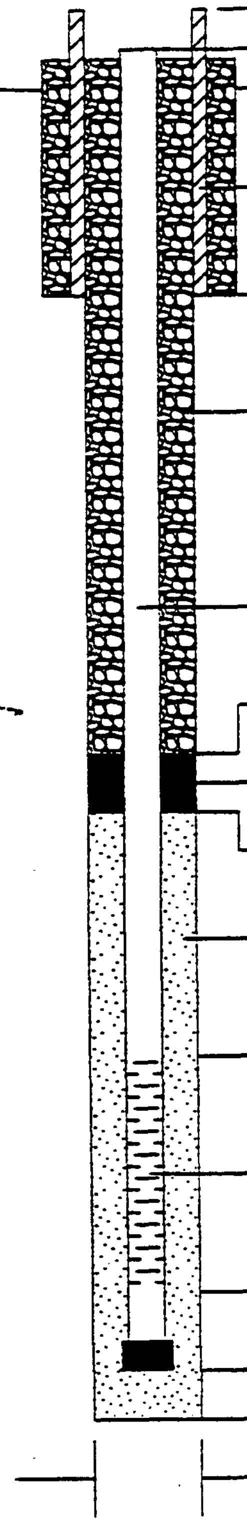
PROJECT	WELL NO.
EMF POCATELLO, ID	172

JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Pond 17	N 449,271.6 : E 551,080.8

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
7-15-97	7-15-97	Dave Kyllonen	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.9	4450.8
TOP OF RISER CASING	-2.7	4450.57
GROUND SURFACE	0.0	4447.9
BOTTOM OF SURFACE CASING	2.2	4445.7
TOP OF SEAL	61.0	4386.9
TOP OF FILTER PACK	69.0	4378.9
TOP OF SCREEN	71.0	4376.9
BOTTOM OF SCREEN	76.0	4371.9
BOTTOM OF SUMP	79.0	4368.9
BOTTOM OF HOLE	79.5	4368.4

SURFACE CASING
DIAMETER: 8-5/8 inch OD
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4-inch ID
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
10-20 Colorado Silica Sand (5 bags)

SCREEN
DIAMETER: 4-inch ID
TYPE: Schedule 40 PVC
OPENING WIDTH: 0.020-inch
TYPE: Machine-cut

HOLE DIAMETER: 10-inches

Update: Oct 13, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	173

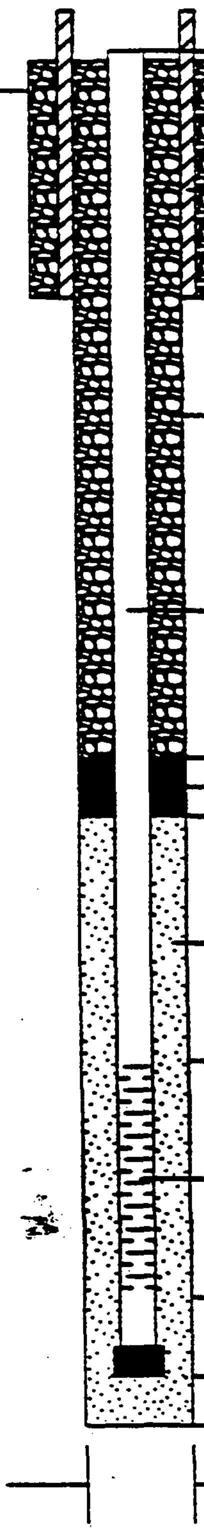
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Pond 17	N 449,231.3 : E 550,171.8

STARTED	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-16-98	10-16-98	L. R. West	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4452.76
TOP OF RISER CASING	-2.8	4452.58
GROUND SURFACE	0.0	4449.8
BOTTOM OF SURFACE CASING	2.0	4447.8
TOP OF SEAL	55.0	4394.8
TOP OF FILTER PACK	65.4	4384.4
TOP OF SCREEN	70.0	4379.8
BOTTOM OF SCREEN	85.0	4364.8
BOTTOM OF SUMP	87.8	4361.9
BOTTOM OF HOLE	89.0	4360.8

SURFACE CASING
DIAMETER: 6"
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
10-20 Colorado Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC
OPENING WIDTH: 0.020"
TYPE: Machine-cut

HOLE DIAMETER: 9 5/8-inches

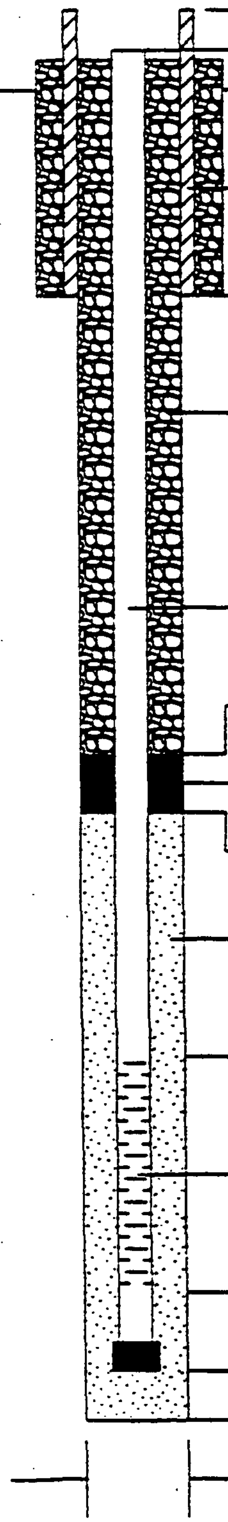
Update: Nov 12, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL	PROJECT: EMF POCATELLO, ID		WELL NO. 180
JOB NO. 20906	SITE: FMC Pond 17	COORDINATES and / or STATIONING: N 449,088.4 : E 550,976.2	
BEGUN: 7-16-97 / COMPLETED: 7-16-97	PREPARED BY: Dave Kyllonen	REFERENCE POINT FOR MEASUREMENTS: Top of PVC Casing-Water Levels	

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4453.1
TOP OF RISER CASING	-2.7	4452.77
GROUND SURFACE	0.0	4450.1
BOTTOM OF SURFACE CASING	2.1	4448.0
TOP OF SEAL	40.0	4410.1
TOP OF FILTER PACK	48.7	4401.4
TOP OF SCREEN	52.2	4397.9
BOTTOM OF SCREEN	62.2	4387.9
BOTTOM OF SUMP	65.2	4384.9
BOTTOM OF HOLE	65.5	4384.6

SURFACE CASING
DIAMETER: 8-5/8 inch OD
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4-inch ID
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
10-20 Colorado Silica Sand (6 bags)

SCREEN
DIAMETER: 4-inch ID
TYPE: Schedule 40 PVC
OPENING WIDTH: 0.020-inch
TYPE: Machine-cut

HOLE DIAMETER: 10-inches

Update: Oct 13, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

WMU # 15 (POND 18)

WELL COMPLETION DIAGRAMS

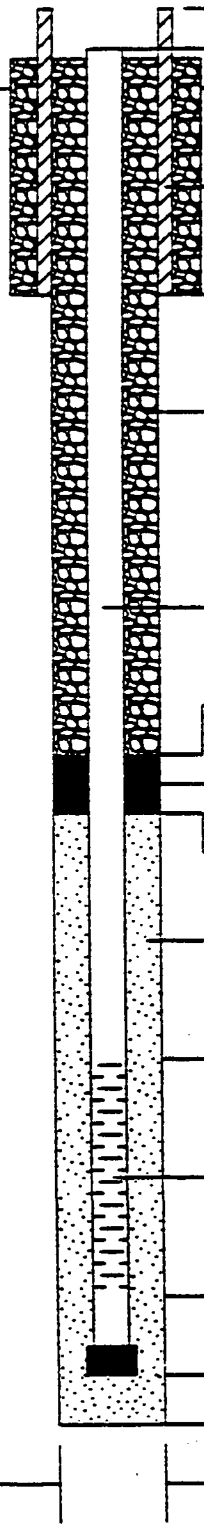
MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	154

JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Corporation	N 449,702.0 : E 550,197.8

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
11-2-92	11-2-92	G. Day	Top of PVC Casing-Water Level

(GENERALIZED GEOLOGIC LOG)



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-2.3	4447.6
TOP OF RISER CASING	-1.7	4447
GROUND SURFACE	0.0	4445.3
BOTTOM OF SURFACE CASING	2.7	4442.6
TOP OF SEAL	63.0	4382.3
TOP OF FILTER PACK	68.0	4377.3
TOP OF SCREEN	73.6	4371.7
BOTTOM OF SCREEN	77.8	4367.5
BOTTOM OF SUMP	81.1	4364.2
BOTTOM OF HOLE	83.0	4362.3

SURFACE CASING
DIAMETER: 8 1/2"
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry- 16-40 Sand

FILTER PACK TYPE
CSSI 10 X 20 Sand

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC / Machine cut
OPENING WIDTH: 0.020"
TYPE:

HOLE DIAMETER: 10-inches

Update: Oct 13, 1997
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	174

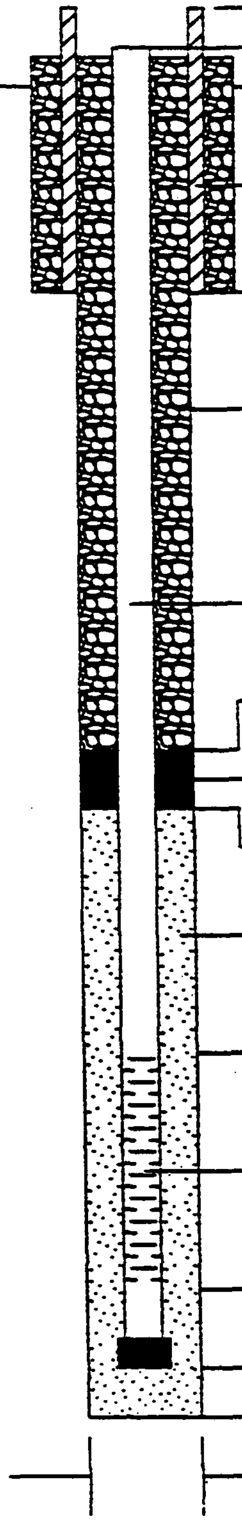
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Pond 18	N 449,232.7 : E 549,303.4

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-15-98	10-15-98	L. R. West	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4447.12
TOP OF RISER CASING	-2.8	4446.92
GROUND SURFACE	0.0	4444.1
SURFACE CASING — DIAMETER: 6" — TYPE: Steel		
BOTTOM OF SURFACE CASING	2.0	4442.1
BACKFILL MATERIAL TYPE — Cement-Bentonite Grout		
RISER CASING — DIAMETER: 4" — TYPE: Schedule 40 PVC		
TOP OF SEAL	60.0	4384.1
ANNULAR SEAL TYPE — Bentonite Slurry		
TOP OF FILTER PACK	70.1	4374.0
FILTER PACK TYPE — 10-20 CSSI Silica Sand		
TOP OF SCREEN	75.0	4369.1
SCREEN — DIAMETER: 4" — TYPE: Sch. 40 PVC — OPENING WIDTH: 0.020" — TYPE: Machine-cut		
BOTTOM OF SCREEN	85.0	4359.1
BOTTOM OF SUMP	87.9	4356.2
BOTTOM OF HOLE	88.0	4356.1
HOLE DIAMETER: 9 5/8-inches		

Update: Nov 12, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	175

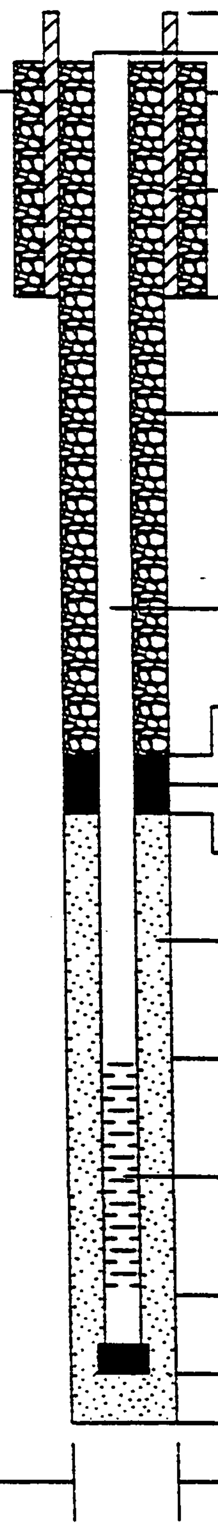
JOB NO.	SITE	COORDINATES and / or STATIONING
[illegible]06	FMC Pond 18	N 449,797.1 : E 549,119.0

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-15-98	10-15-98	L. R. West	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.

[illegible]T TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4443.59
TOP OF RISER CASING	-2.9	4443.46
GROUND SURFACE	0.0	4440.6
BOTTOM OF SURFACE CASING	2.0	4438.6
TOP OF SEAL	57.0	4383.6
TOP OF FILTER PACK	67.0	4373.6
TOP OF SCREEN	72.0	4368.6
BOTTOM OF SCREEN	82.0	4358.6
BOTTOM OF SUMP	84.9	4355.7
BOTTOM OF HOLE	85.0	4355.6

SURFACE CASING
DIAMETER: 6"
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
10-20 CSSI Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC
OPENING WIDTH: 0.020"
TYPE: Machine-cut

HOLE DIAMETER: 9 5/8-inches

Update: Nov 12, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	176

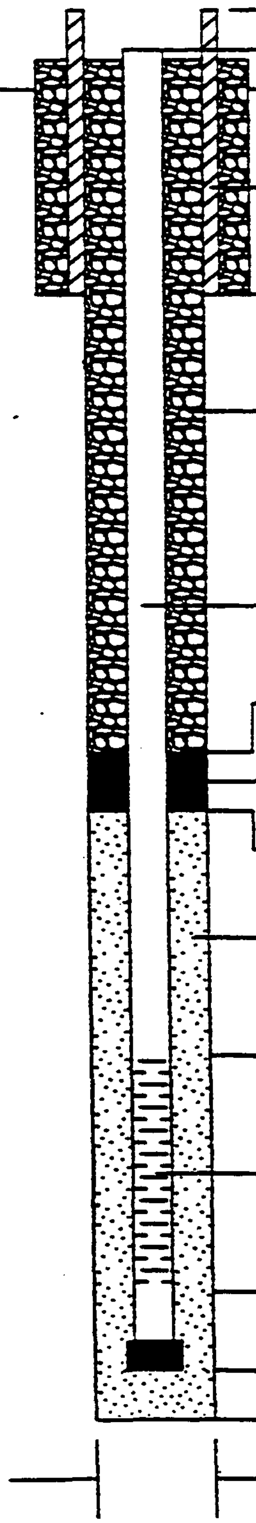
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Pond 18	N 450,291.6 : E 550,019.0

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-14-98	10-14-98	L. R. West	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4443.29
TOP OF RISER CASING	-2.8	4443.13
GROUND SURFACE	0.0	4440.3
BOTTOM OF SURFACE CASING	2.0	4438.3
TOP OF SEAL	60.5	4379.8
TOP OF FILTER PACK	70.5	4369.8
TOP OF SCREEN	74.8	4365.5
BOTTOM OF SCREEN	84.8	4355.5
BOTTOM OF SUMP	87.4	4352.9
BOTTOM OF HOLE	88.0	4352.3

SURFACE CASING
DIAMETER: 6"
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
10-20 CSSI Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC
OPENING WIDTH: 0.020"
TYPE: Machine-cut

HOLE DIAMETER: 9 5/8-inches

Update: Nov 12, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

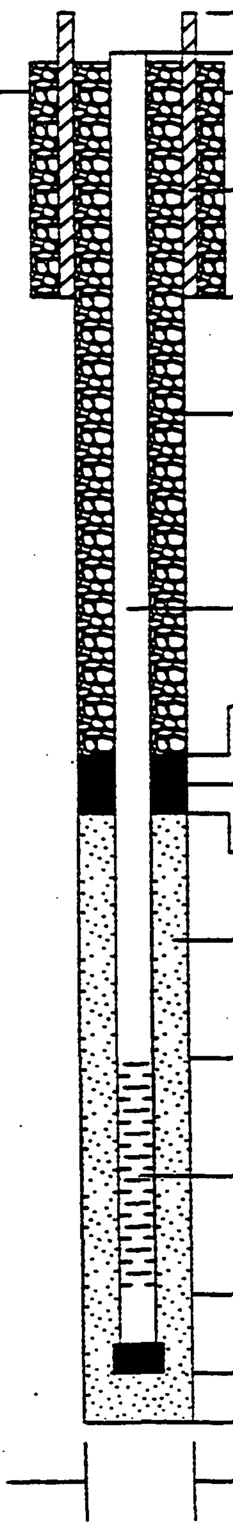
MONITORING WELL	PROJECT EMF POCATELLO, ID		WELL NO. 177
JOB NO. [illegible]06	SITE FMC Pond 18	COORDINATES and / or STATIONING N 450,022.2 : E 550,106.4	

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-13-98	10-13-98	L. R. West	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.

TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4444.95
TOP OF RISER CASING	-2.7	4444.61
GROUND SURFACE	0.0	4442.0
BOTTOM OF SURFACE CASING	2.0	4440.0
TOP OF SEAL	61.4	4380.6
TOP OF FILTER PACK	71.4	4370.6
TOP OF SCREEN	75.1	4366.9
BOTTOM OF SCREEN	85.1	4356.9
BOTTOM OF SUMP	88.0	4354.0
BOTTOM OF HOLE	88.4	4353.6

SURFACE CASING
DIAMETER: 6"
TYPE: Steel

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER: 4"
TYPE: Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
10-20 CSSI Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC
OPENING WIDTH: 0.020"
TYPE: Machine-cut

HOLE DIAMETER: 9 5/8-inches

Update: Nov 12, 1998
Report Form: EMF-WELLOG2

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	178

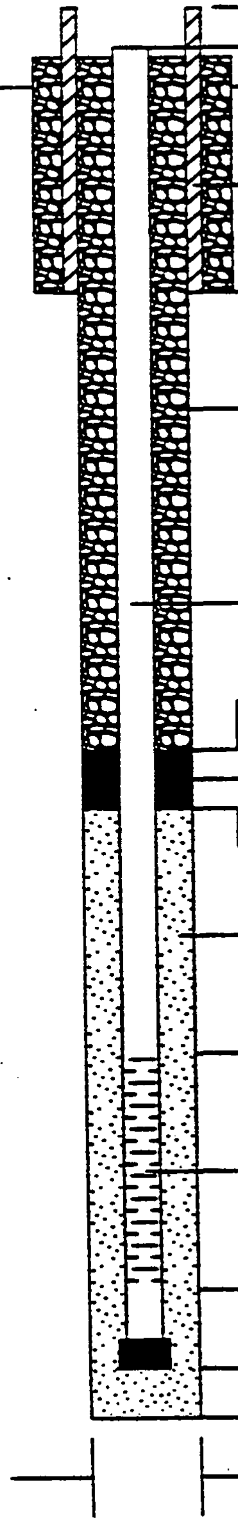
JOB NO.	SITE	COORDINATES and / or STATIONING
20906	FMC Pond 18	N 449,473.9 : E 550,275.2

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-12-98	10-13-98	L. R. West	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	-3	4451.47
TOP OF RISER CASING	-2.7	4451.14
GROUND SURFACE	0.0	4448.5
SURFACE CASING — DIAMETER: 8" TYPE: Steel		
BOTTOM OF SURFACE CASING	2.0	4446.5
BACKFILL MATERIAL TYPE — Cement-Bentonite Grout		
RISER CASING — DIAMETER: 4" TYPE: Schedule 40 PVC		
TOP OF SEAL	46.0	4402.5
ANNULAR SEAL TYPE — Bentonite Slurry		
TOP OF FILTER PACK	56.4	4392.1
FILTER PACK TYPE — 10-20 CSSI Silica Sand		
TOP OF SCREEN	60.0	4388.5
SCREEN — DIAMETER: 4" TYPE: Sch. 40 PVC OPENING WIDTH: 0.020" TYPE: Machine-cut		
BOTTOM OF SCREEN	75.0	4373.5
BOTTOM OF SUMP	77.8	4370.7
BOTTOM OF HOLE	78.5	4370.0

HOLE DIAMETER: 9 5/8-inches

Update: Nov 12, 1998

Report Form: EMF-WELLOG2

NOT TO SCALE

Attachment 10-2b

Field Sampling Plan for RCRA Cap Monitoring

Field Sampling Plan for RCRA Cap Monitoring

1. INTRODUCTION

This field sampling plan (FSP) implements quality control requirements for RCRA temperature, pressure and gas monitoring specified in the Quality Assurance Project Plan (QAPjP) for Waste Management Units (WMUs) at the former FMC Corporation Pocatello Elemental Phosphorus Plant. This FSP and the associated QAPjP constitute the RCRA sampling and analysis plan (SAP) for temperature, pressure, and gas monitoring for the WMUs closed with waste in-place using a RCRA cap.

1.1 Background

FMC Corporation (referred to as FMC, hereafter) owns and is decommissioning its former elemental phosphorus production plant in southeast Idaho, located approximately 3 miles west of Pocatello. The plant operation included WMUs that are primarily surface impoundments that are being closed in accordance with RCRA closure requirements specified in 40 CFR Part 265. The facility ceased producing elemental phosphorus from phosphate ore in December 2001.

Closure Plans for closing specific WMUs in place as RCRA hazardous waste landfills include placing a cap over the pond sediment. The objective is to reduce and control potential migration of waste constituents from the pond sediment into the surrounding soil and underlying groundwater.

Closures for RCRA capped WMUs are expected to be complete approximately thirty six to forty eight months after approval of a Closure Plan, depending on a pond solids' consolidation rate. After a closure is complete, temperature and pressure will be monitored continuously and soil gas will be sampled, when triggered by exceedences of temperature and pressure measurement criteria.

Gases may be generated within the landfill by biological activity, escape of entrained gases, vaporization of liquids or chemical reactions. The waste buried in the landfill is composed of fine grained ore, coke, silica, phosphorus, and dirt. These mineral particles are not likely to biologically decompose or vaporize. There are no gases entrained in the small buried particles, but phosphine may have been dissolved in the water used to slurry the particles. Therefore, chemical reactions, although not anticipated, are the potential mechanism by which gas may be generated. Monitoring temperature and pressure will provide an early indication of whether chemical reactions are occurring.

1.2 Previous Results

The following observations made at Pond 8S are relevant to activities that will occur at the WMUs that will undergo closure with a RCRA cap. Temperature monitoring at Pond 8S indicates that the temperature at the pond sediment–fill interface is below 22° C. This temperature is below the melting point and vapor point of the inorganic constituents contained in the pond sediment, so gas generation by volatilization is unlikely. Groundwater temperature in monitoring wells downgradient of Pond 8S is not elevated compared to the temperature in upgradient wells. During groundwater sampling conducted in November 2000, the temperature of groundwater from upgradient well 158 was 15.9° C compared to 13.8° C, 14.9° C, and 15° C measured in downgradient wells 155, 156, and 157, respectively. The downgradient wells are within 100 feet of the exterior pond berm. In addition, the temperature at the bottom of the western observation well in Pond 8S was measured by FMC to be 17° C. The bottom of the observation well is approximately 26 feet below the top of the temporary cap and corresponds to the depth of the pond sediment–fill interface.

Other observations of the condition at Pond 8S provide evidence that chemical reactions in the pond sediments are not occurring, at least not at an observable rate. There was no evidence of phosphine gas generation under the temporary cap, in the dewatering system piping, or in observation wells installed as part of the temporary dewatering system in the pond. On July 1, 1997, a phosphine gas meter was used to monitor soil gas beneath the temporary cap, in the dewatering system piping and in observation wells in Pond 8S. The phosphine gas concentration measured at each of these monitoring locations was less than 0.01 ppm phosphine, the detection limit of the gas detector. There was no evidence of phosphine gas generation under the final cap.

Phosphine buildup was detected, however, at the western anchor trench of the Pond 16S temporary cover in early spring 2001. This buildup is potentially attributable to the phosphine released during sludge intrusive activities of the center dike construction which was trapped by the immediate construction of the initial fill and temporary cover. With the exception of Pond 16S, observation of conditions at all other ponds that have been backfilled provides supporting evidence that there is no indication of significant (observable) phosphine buildup under the temporary covers.

2. MONITORING OBJECTIVES

The overall objective of the temperature and pressure monitoring program is to determine if chemical reactions are occurring under the closure cap and if so, provide immediate notification. Such reactions may compromise the integrity of the closure cap by generating temperature and pressure increases under the cap as a consequence of the heat of reaction and generation of gaseous reaction products. Some of the potential gaseous reaction products may be hazardous to human health and the environment. To meet this objective, data of known quality will be collected, analyzed, and reported.

3. MONITORING LOCATIONS AND FREQUENCY

The RCRA cap monitoring list is presented in Table 1. Appendix A contains a figure for each of the WMUs with a RCRA cap. These figures illustrate the temperature and pressure monitoring locations for the listed WMUs.

TABLE 1
WMU-SPECIFIC RCRA CAP MONITORING POINTS

		Cap Monitoring I.D. Numbers		
WMU No.	**WMU Name**	**Temperature**	**Pressure**	**Gas Monitoring**
3	Phossy Waste Surface Impoundment (Pond 15S)	T01 to T010	Pressure Monitoring Station P01	NA
7	Phossy Waste Surface Impoundment (Pond 8S)	T01 to T04	Pressure Monitoring Station P01	GM-1 through GM-10 (around perimeter at toe of the final cap)
8	Phossy Water Clarifier Surface Impoundments (11S, 12S, 13S, and 14S) – Phase IV Ponds	T01 to T013	Pressure Monitoring Stations P01 to P04	NA
9	Precipitator Slurry Drying Surface Impoundment (Pond 9E)	T01 to T010	Pressure Monitoring Station P01	NA
10	Phossy Waste Surface Impoundment (Pond 16S)	T01 to T08	Pressure Monitoring Station P01	NA
11	Precipitator Slurry Surface Impoundment (Pond 8E)	T01 to T04	Pressure Monitoring Station P01	NA
14	Pond 17	T01 to T06	Pressure Monitoring Station P01	NA
15	Pond 18	NA	NA	NA
	Pond 18, Cell A	T01 to T04	Pressure Monitoring Station P01	NA

3.1 Temperature Monitoring

The temperature monitoring points will be located to provide monitoring points representative of the areal extent of the cap. Temperature will be continuously monitored and recorded. If the temperature at any one of the monitoring locations exceeds 22° C, then an alarm will sound and the FMC Environmental Manager will be notified immediately. If an alarm indicates the temperature exceeds 22° C, then soil gas sampling will be conducted.

3.2 Pressure Monitoring

Pressure will be monitored in a soil gas collection pipe under the closure cap. The collection pipe encircles the cap and has a pipe(s) through the center of the pond. Pressure will also be continuously monitored and recorded. If the pressure under the cap exceeds 27 inches of mercury absolute pressure (equivalent to a pressure of approximately 31.9 inches of mercury at mean sea level), then an alarm will light and the FMC Environmental Manager will be notified immediately. If an alarm indicates the pressure exceeds 27 inches of mercury, then soil gas sampling will be conducted.

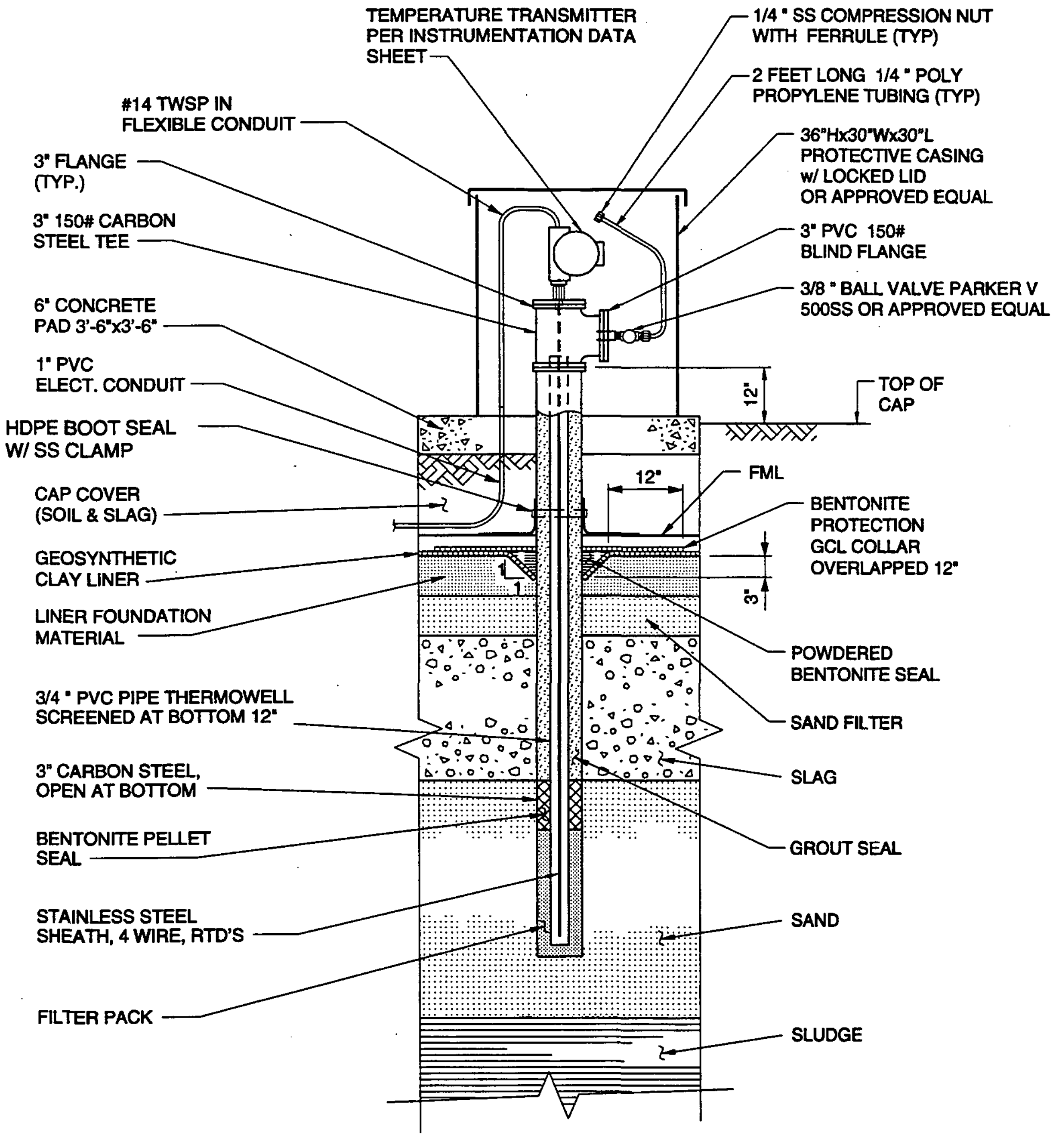
3.3 Soil Gas Sampling

Soil gas sampling will be conducted from the temperature monitoring wells. Soil gas sampling will only be conducted if the temperature under the cap exceeds 22° C and/or the absolute pressure exceeds 27 inches of mercury.

Soil gas monitoring wells have been installed around the perimeter of Pond 8S at the toe of the cap. These gas sampling wells are sampled quarterly and are unique to Pond 8S (WMU No. 7).

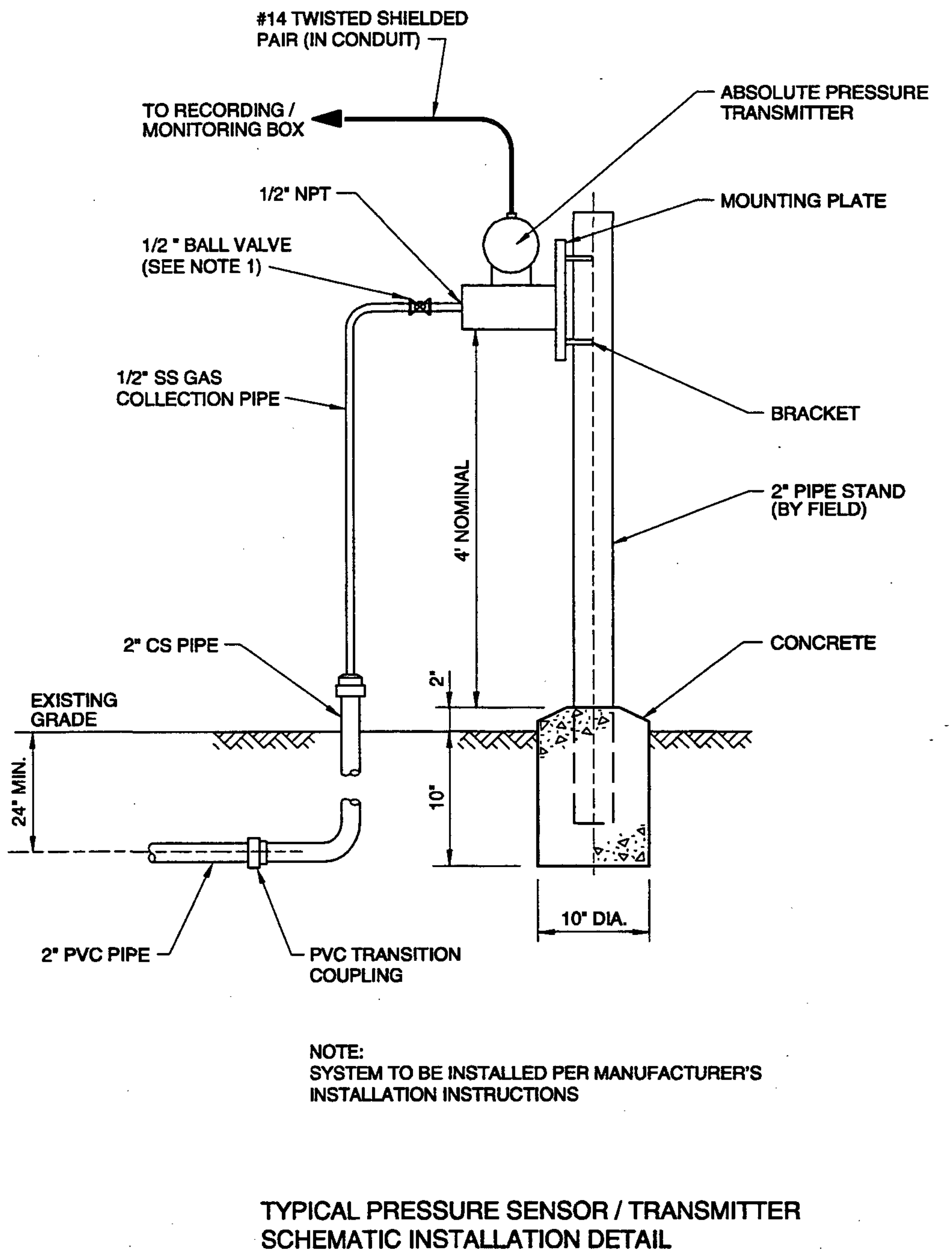
4. MONITORING PROCEDURES

This section describes the procedures to be used to record results and monitor temperature, pressure and, if required, soil gas. All monitoring will be conducted in accordance with the procedures presented in this section. Figure 1 depicts the temperature monitoring well [T01]. Figure 2 depicts the pressure monitoring station [P01].



\members\fsp rcra\fig1.dgn

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO LLC POCATELLO, IDAHO			
Temperature Monitoring Well Typical Section			
BECHTEL	Job Number	Drawing No.	Rev.
	24230	Figure 1	0



BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC IDAHO LLC
POCATELLO, IDAHO

Pressure Monitoring Station (PO1)

Job Number	Drawing No.	Rev.
24230	Figure 2	0

4.1 Field Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. At a minimum, the following monitoring information will be recorded:

- Monitoring location and description.
- Monitor's name(s).
- Date and time of inspection and monitoring.
- Dates and time period for the data being downloaded from the digital recorder (DRM) to a portable computer.
- Type of monitoring equipment used.
- Measurement data (e.g. hydrogen , hydrogen cyanide and phosphine concentrations). The data should include the numerical value and the units of each measurement.
- Field observations and details important to interpreting the monitoring results (e.g., heavy rains, odors, colors).

The sample identification and codes are not used in the logbook. The information and data is included on the pond's portable computer (PC) inspection record form and electronically in the data logger and PC used to download the temperature and pressure. A code will be used to identify the matrix monitored. "SG" will be used for soil gas, "T" for temperature, and "P" for pressure. A two or three character combination will identify the monitoring location, as follows:

- Temperature monitoring locations: T01 through T0n; where n is the number of locations.
- Pressure monitoring locations: P01. There is only one pressure monitoring location per pond.
- Soil gas sampling locations (at temperature monitoring wells): T01 through T0n.
- Soil gas monitoring at gas monitoring wells for Pond 8S only: GM-1 through GM-10. Figure 3 depicts the gas monitoring well [GM-1].

The date(s) of monitoring (monitoring period) will be indicated in mm/dd/yy format, and the time will be indicated in accordance with the military convention. The monitored parameter will be indicated in an unambiguous shorthand, such as H_2 for hydrogen. Temperature will be recorded in degrees Celsius. Pressure will be recorded in inches of mercury and soil gas concentration will be recorded in ppm.

4.1 Field Logbooks

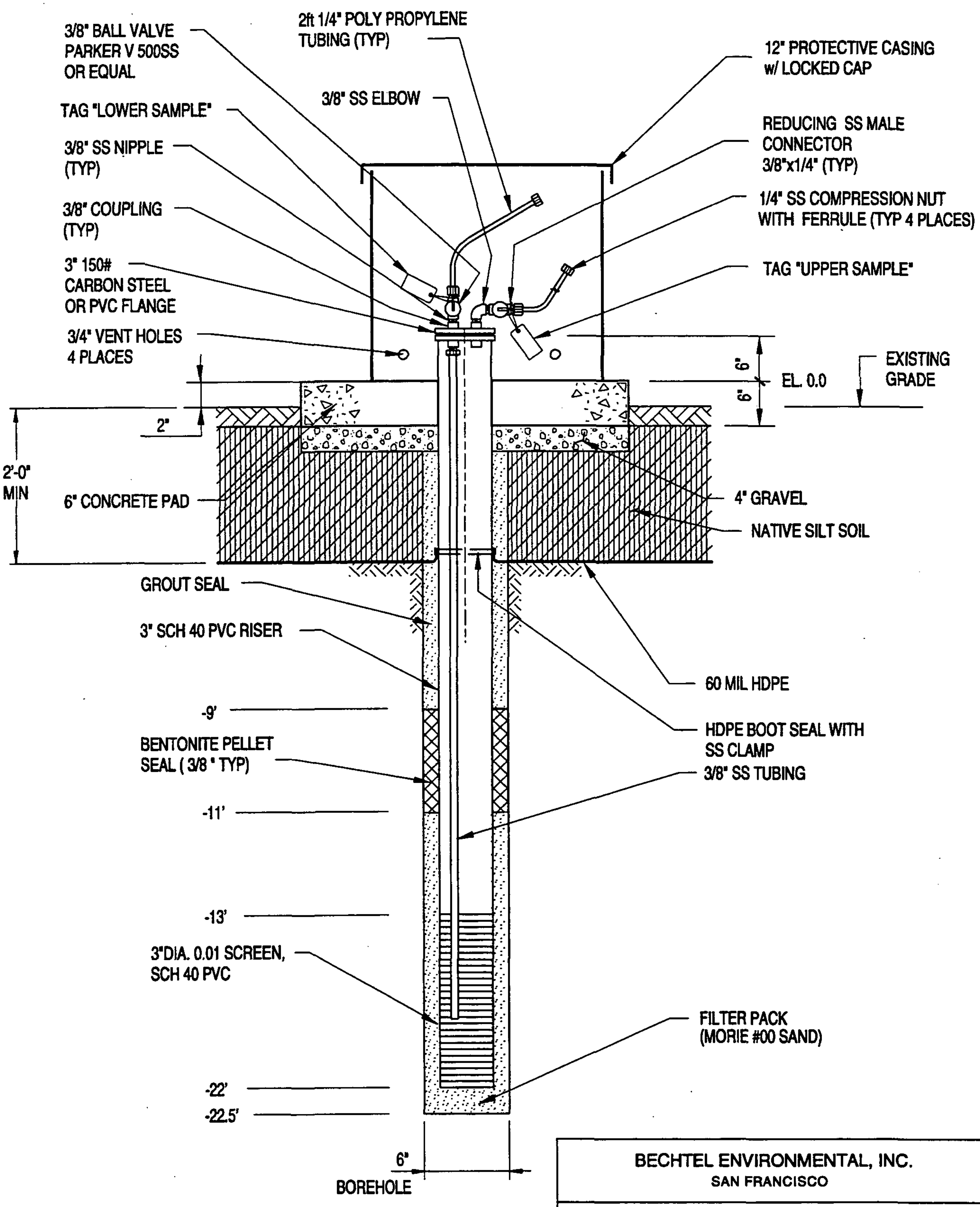
Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. At a minimum, the following monitoring information will be recorded:

- Monitoring location and description.
- Monitor's name(s).
- Date and time of inspection and monitoring.
- Dates and time period for the data being downloaded from the DRM to a portable computer.
- Type of monitoring equipment used.
- Measurement data (e.g. hydrogen , hydrogen cyanide and phosphine concentrations). The data should include the numerical value and the units of each measurement.
- Field observations and details important to interpreting the monitoring results (e.g., heavy rains, odors, colors).

The sample identification codes are used, as appropriate, in the logbook. The start and stop dates for the data collected and downloaded to the portable computer. Letter codes will be used to identify the matrix monitored. "SG" will be used for soil gas, "T" for temperature, and "P" for pressure. A two or three character combination will identify the monitoring location, as follows:

- Temperature monitoring locations: T01 through T0n; where n is the number of locations.
- Pressure monitoring locations: P01. There is only one pressure monitoring location per pond.
- Soil gas sampling locations (at temperature monitoring wells): T01 through T0n.
- Soil gas monitoring at gas monitoring wells for Pond 8S only: GM-1 through GM-10. Figure 3 depicts the gas monitoring well [GM-1].

The date(s) of monitoring (monitoring period) will be indicated in mm/dd/yy format, and the time will be indicated in accordance with the military convention. The monitored parameter will be indicated in an unambiguous shorthand, such as H_2 for hydrogen. Temperature will be recorded in degrees Celsius. Pressure will be recorded in inches of mercury and soil gas concentration will be recorded in ppm.



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\Members\fsp rcra\fig3.dgn

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO			
FMC IDAHO LLC POCATELLO, IDAHO			
SOIL GAS MONITORING WELL CONSTRUCTION PROFILE (GM-1)			
BECHTEL	Job Number	Drawing No.	Rev.
	24230	Figure 3	0

Logbooks will be rain-resistant and bound with consecutively numbered pages. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in black, waterproof ink, and signed by the individual making the entries. The person recording the notes will sign and date the bottom of every page in the field notebook. Changes will be crossed out with a single line so that the original text remains legible; the change will be initialed and dated. Unused portions of logbook pages will be crossed out, signed, and dated by the assigned individual at the end of each workday. Language will be factual, objective, and free of personal opinions or inappropriate terminology. In addition to the sampling information, the following specifics will also be recorded in the field logbook:

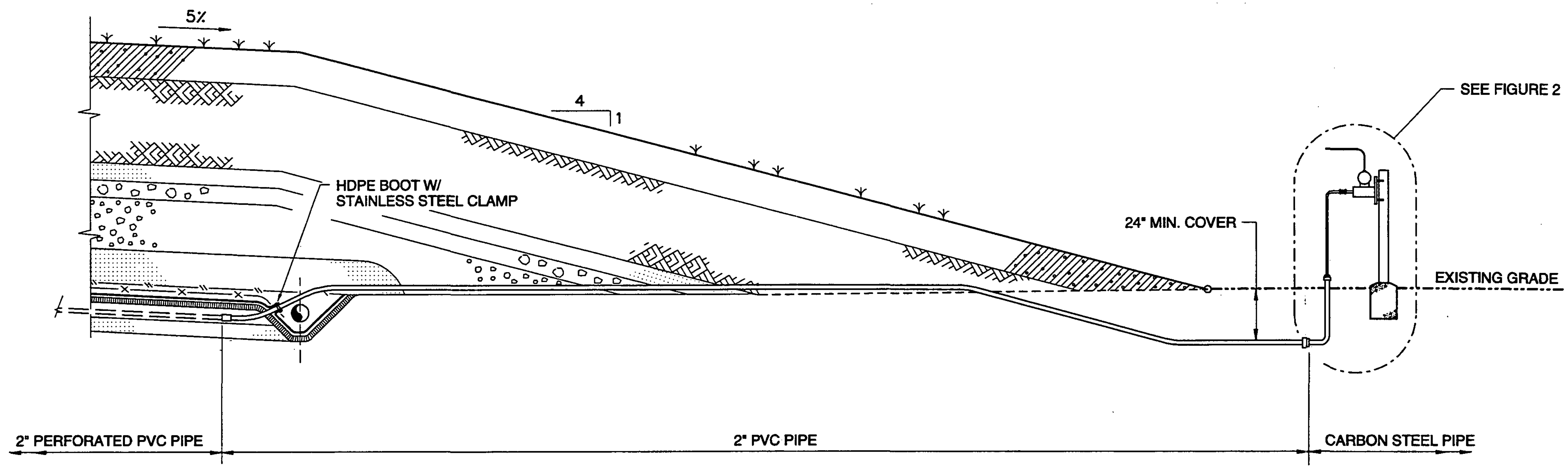
- Team members.
- Time of site arrival/entry on site and time of site departure.
- Other personnel on site.
- Any deviations from sampling plan, site safety plan, and quality control procedures.
- Any changes in personnel and responsibilities as well as reasons for the changes.
- Equipment calibration and equipment model and serial number.

4.2 Temperature Monitoring

Temperature at each of the monitoring locations will be continuously monitored and recorded by a data logger equipped with a high temperature alarm. If the temperature at any of the monitoring locations exceeds 22° C, an alarm will sound on the alarm box, and an externally visible light will go on to designate the problem well. On a quarterly basis or more frequently as dictated by DRM storage capacity, the continuous temperature record will be electronically transferred from the data logger to a portable computer for archive and analysis of temperature trends.

4.3 Pressure Monitoring

Pressure in the soil gas collection system will be continuously monitored and recorded by a data logger equipped with a high pressure alarm. If the pressure exceeds 27 inches of mercury absolute pressure, the alarm will sound on the alarm box, and an externally visible light will go on. On a quarterly basis or more frequently as dictated by DRM storage capacity, the continuous pressure record will be electronically transferred from the data logger to a portable computer for archive and analysis of pressure trends. Figure 4 shows a typical final RCRA end cap section from the Ponds 8S final cap.



Pond 8S (Section A on Drawing 100-C-203)

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC IDAHO LLC
POCATELLO, IDAHO

Typical Final RCRA End Cap Section

Job Number	Drawing No.	Rev.
24230	Figure 4	1

4.4 Soil Gas Sampling

Each of the temperature monitoring wells will be equipped with a gas sampling fitting. The fitting will be connected to the thermal well.

Hydrogen monitoring will be conducted first because it is lighter and is expected to collect at the top of the casing. The portable soil gas monitor with the hydrogen detector will be connected to the fitting. The monitoring valve will be opened and the monitor will be energized to start the pump. Monitoring will continue until the displayed concentration does not change appreciably with time. The maximum measured concentration and the final measured concentration will be recorded in the field logbook. The monitoring valve will be closed and the soil gas monitor disconnected from the fitting.

Phosphine monitoring will be conducted after hydrogen monitoring. The soil gas monitor with the phosphine detector will be connected to the fitting. The monitoring valve will be opened and the monitor will be energized to start the pump. Monitoring will continue until the displayed concentration does not change appreciably with time. The maximum measured concentration and the final measured concentration will be recorded in the field logbook. The monitoring valve will be closed and the soil gas monitor disconnected from the fitting. Additional information on gas monitoring is contained in Section 7.1.4.1 of the Closure Plan and in Section 2.4.2.3 of the QAPjP. If phosphine is detected, the soil gas monitor will be turned off, the monitoring valve will be closed, the soil gas monitor will be disconnected from the fitting. The soil gas monitor with the hydrogen cyanide detector will then be re–connected to the fitting. The monitoring valve will be opened and the monitor will be energized to start the pump. Monitoring will continue until the displayed concentration does not change appreciably with time. The maximum measured concentration and the final measure concentration will be recorded in the field logbook. The monitoring valve will be closed and the soil gas monitor disconnected from the fitting.

4.5 Equipment Decontamination Procedure

Equipment for temperature, pressure, and if required soil gas sampling will not require decontamination. All of the monitoring equipment, except the soil gas monitor, will be dedicated to a specific monitoring location. As a result, there is no possibility of cross contamination. The soil gas collection tubing is dedicated to each well, so only the monitor will be moved from location to location for use. Since hydrogen, phosphine and hydrogen cyanide are gases at ambient temperature and pressure, the monitor will be decontaminated by pumping ambient air through the detectors for several minutes prior to use at each soil gas monitoring location.

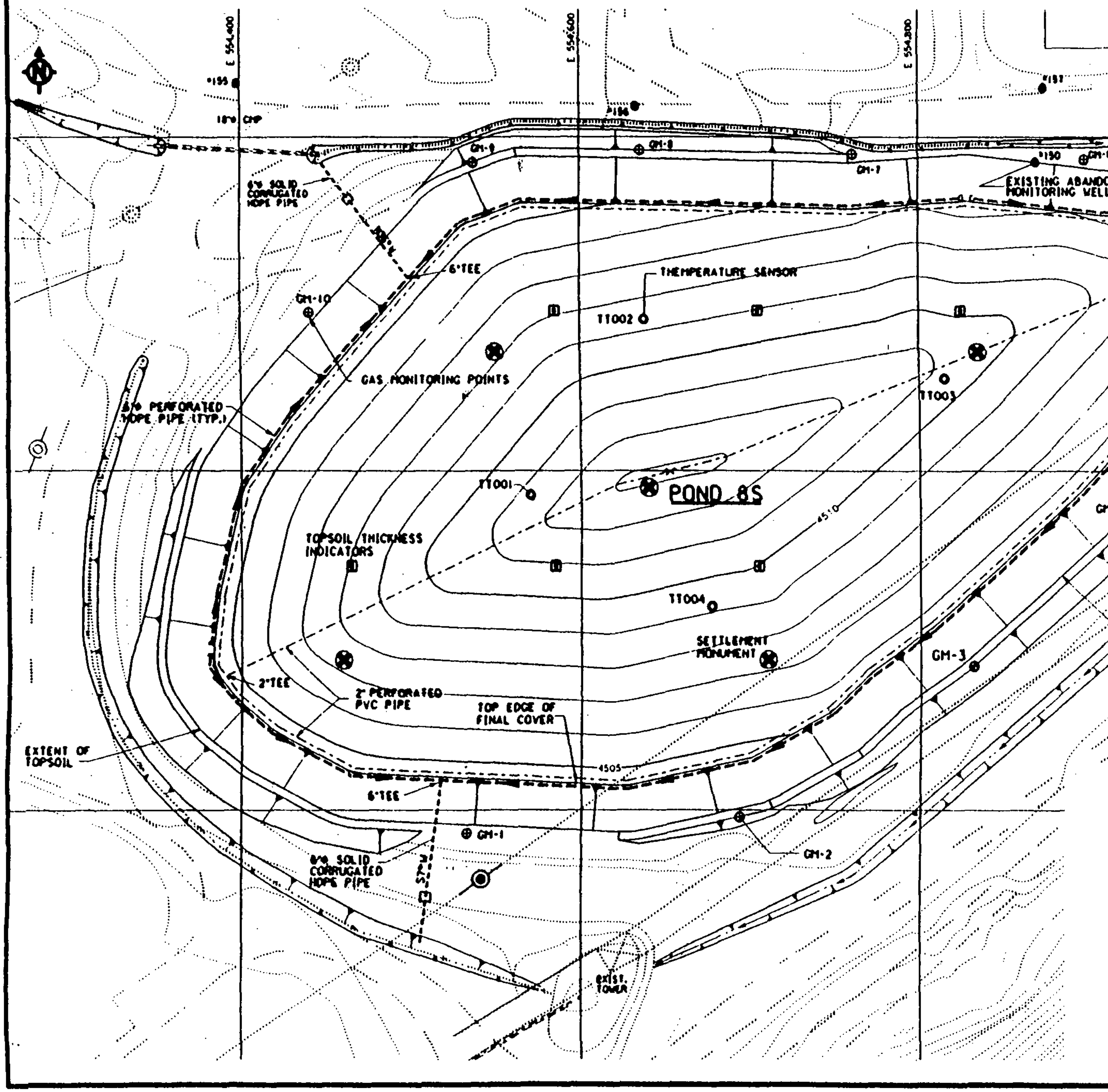
5. DISPOSAL OF WASTE

Used PPE will be bagged and accumulated in dumpsters onsite for disposal in an onsite landfill. Any PPE that could be considered reusable will be rendered inoperable before disposal.

Appendix A

Temperature and Pressure Monitoring Systems and Locations for WMUs

\SFOSB058\BNI-CAD\GHES\FMC-RCRA\8SCLOSE\NEWFIG.DGN 04/23/1998 RHS

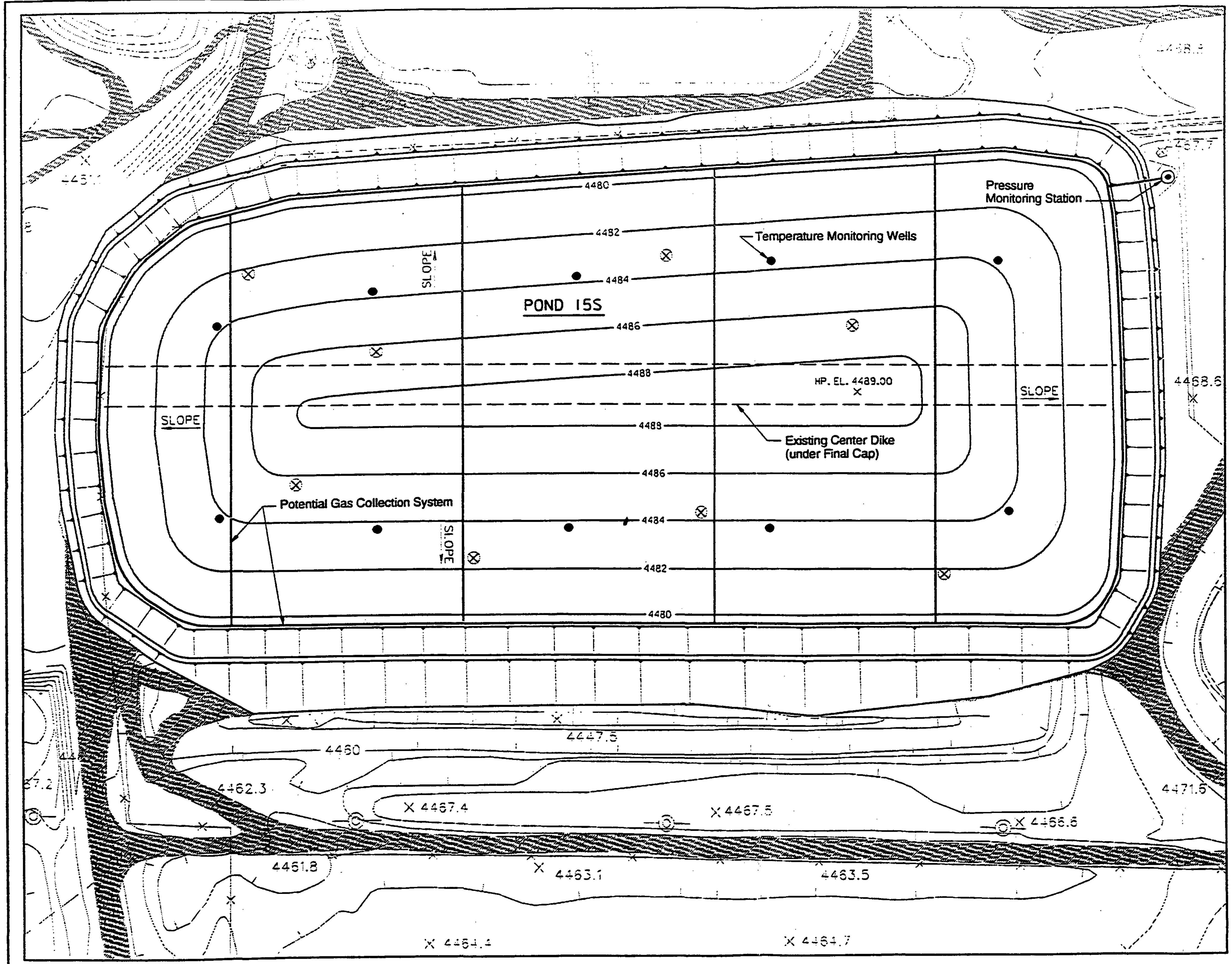


BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC CORPORATION
POCATELLO, IDAHO

TEMPERATURE, PRESSURE & GAS MONITORING LOCATIONS

JOB NO	DRAWING NO	REV
20906	Figure 4	0



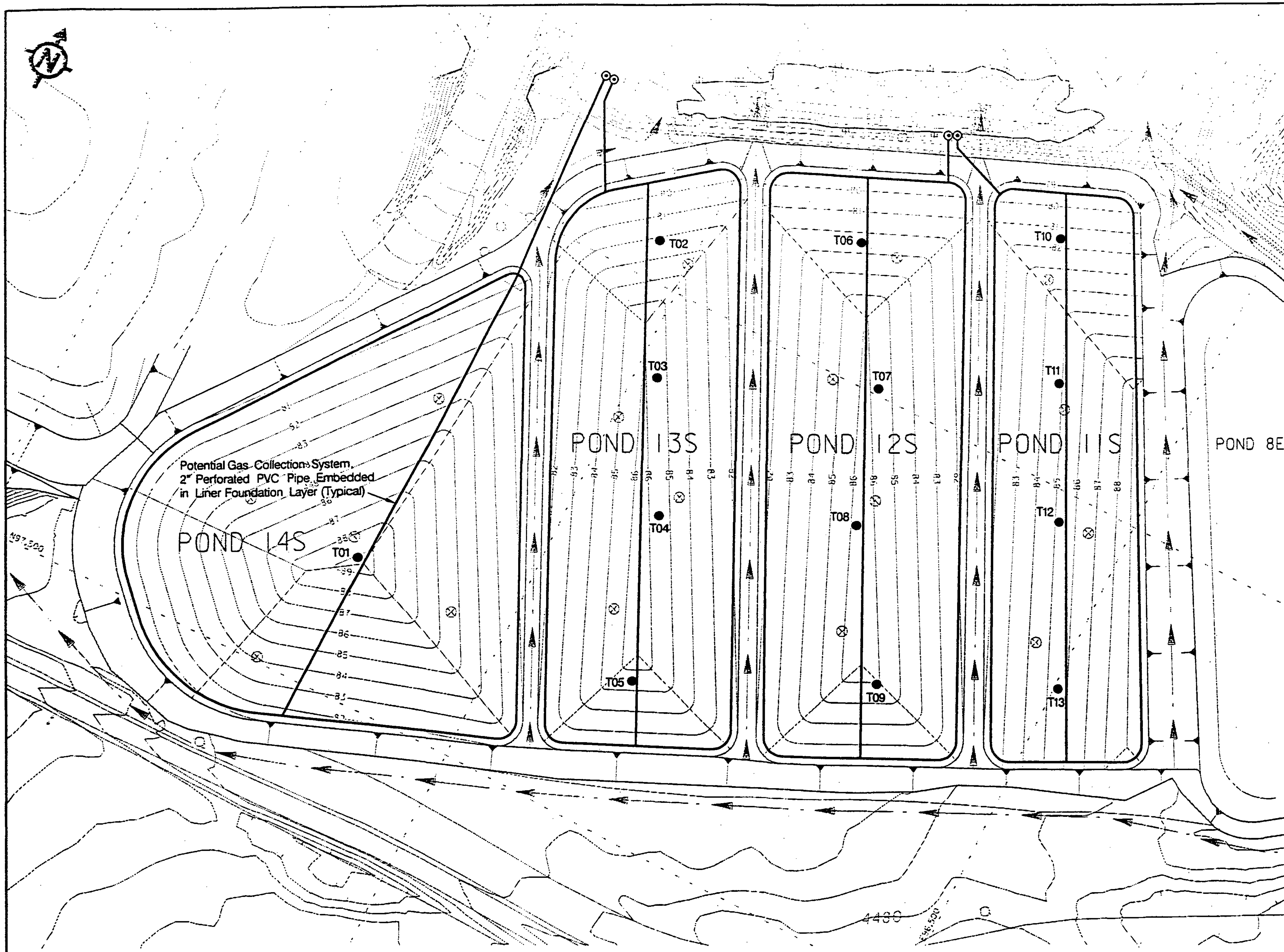
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

ASTARIS IDAHO, LLC
POCATELLO, IDAHO

Pond 15S
Pressure and Temperature Monitoring System

Job Number	Drawing No.	Rev.
24230	Figure 1	0

Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.



Legend

- T10 ● Temporary Monitoring Well
- ⊙ Pressure Monitoring Station
- —— Potential Gas Collection System

60 30 0 60 120 FT

GRAPHIC SCALE

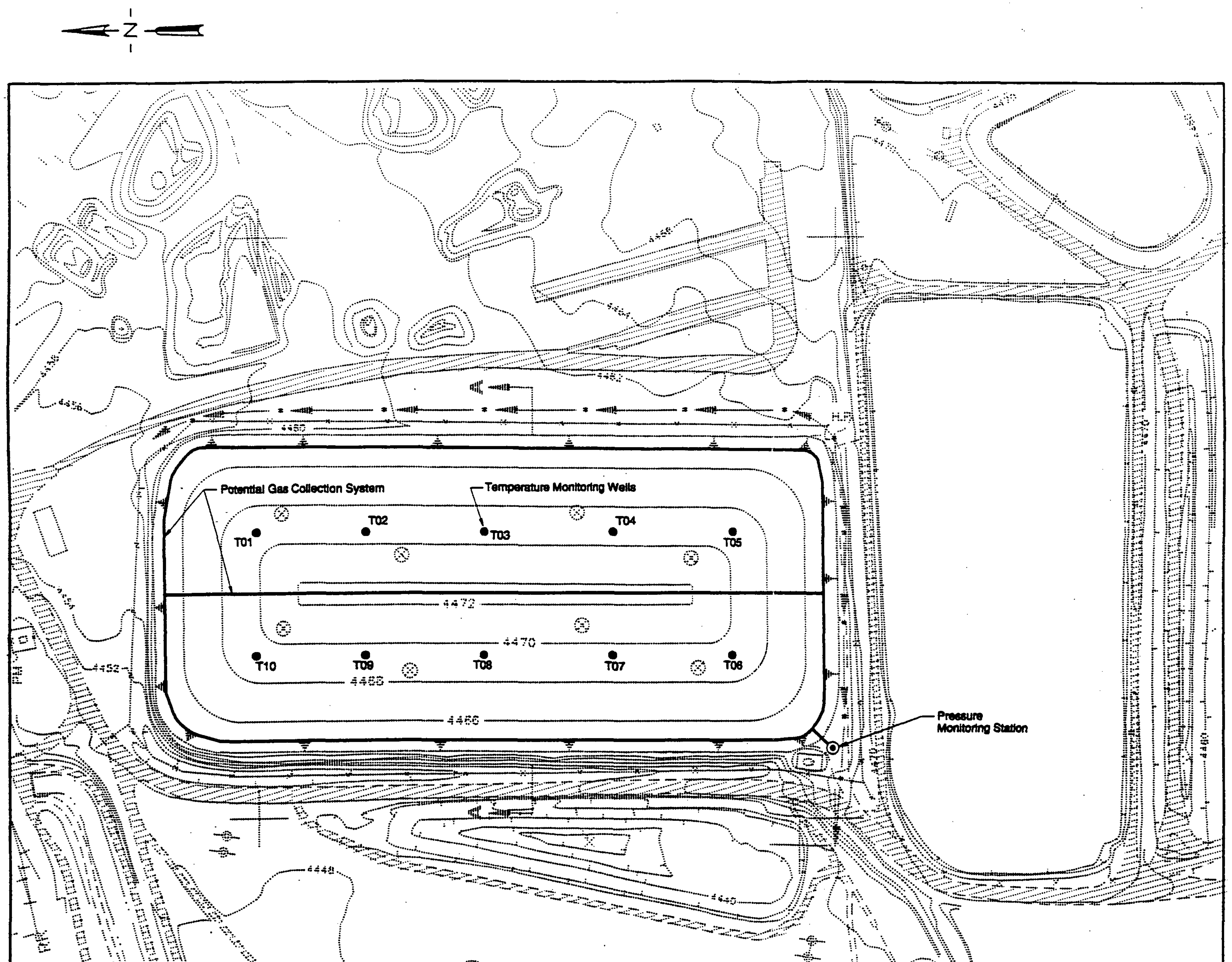
Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

ASTARIS IDAHO, LLC
POCATELLO, IDAHO

Phase IV Ponds
Pressure and Temperature Monitoring System

Job Number	Drawing No.	Rev.
24230	Figure 1	1



LEGEND

- T01 ● Temperature Monitoring Wells
- ⊙ Pressure Monitoring Station
- ——— Potential Gas Collection System

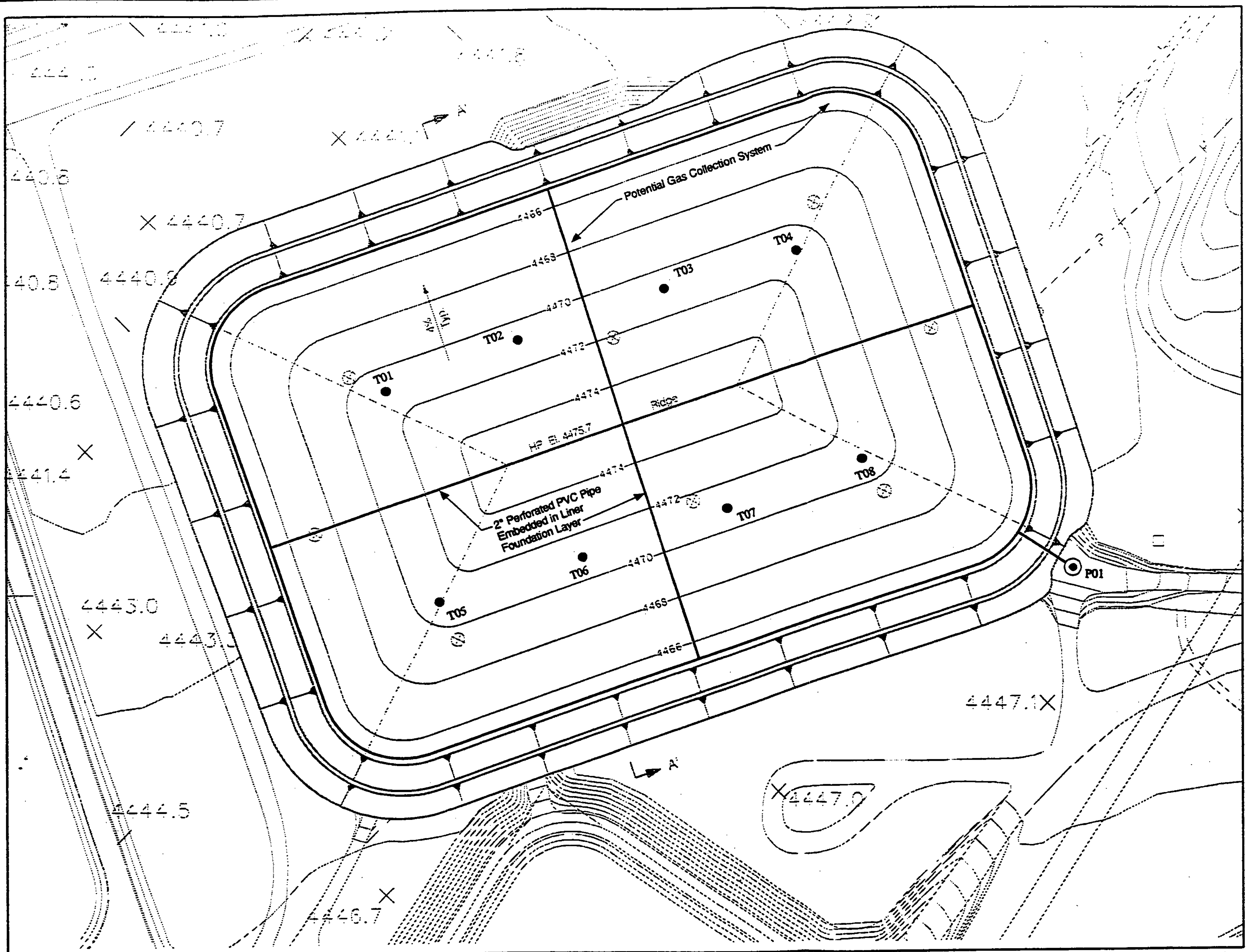
0 200 FT

SCALE

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC CORPORATION POCATELLO, IDAHO		
Temperature and Pressure Monitoring Systems		
Job No.	Drawing No.	Rev.
20906	Figure 1	0

Reference: Vertical Datum is mean sea level.
Horizontal Datum is North American Datum 1983.
Date of Photography: June 1992.

9EFIG1.DGN / AUG 15 1998 / LMALY



Legend

T01 ●	Temperature Monitoring Wells
P01 ⊙	Pressure Monitoring Station
———	Potential Gas Collection System

0 100 200 FEET
0 20 40 60 METERS

N

Pond 16S - Plan

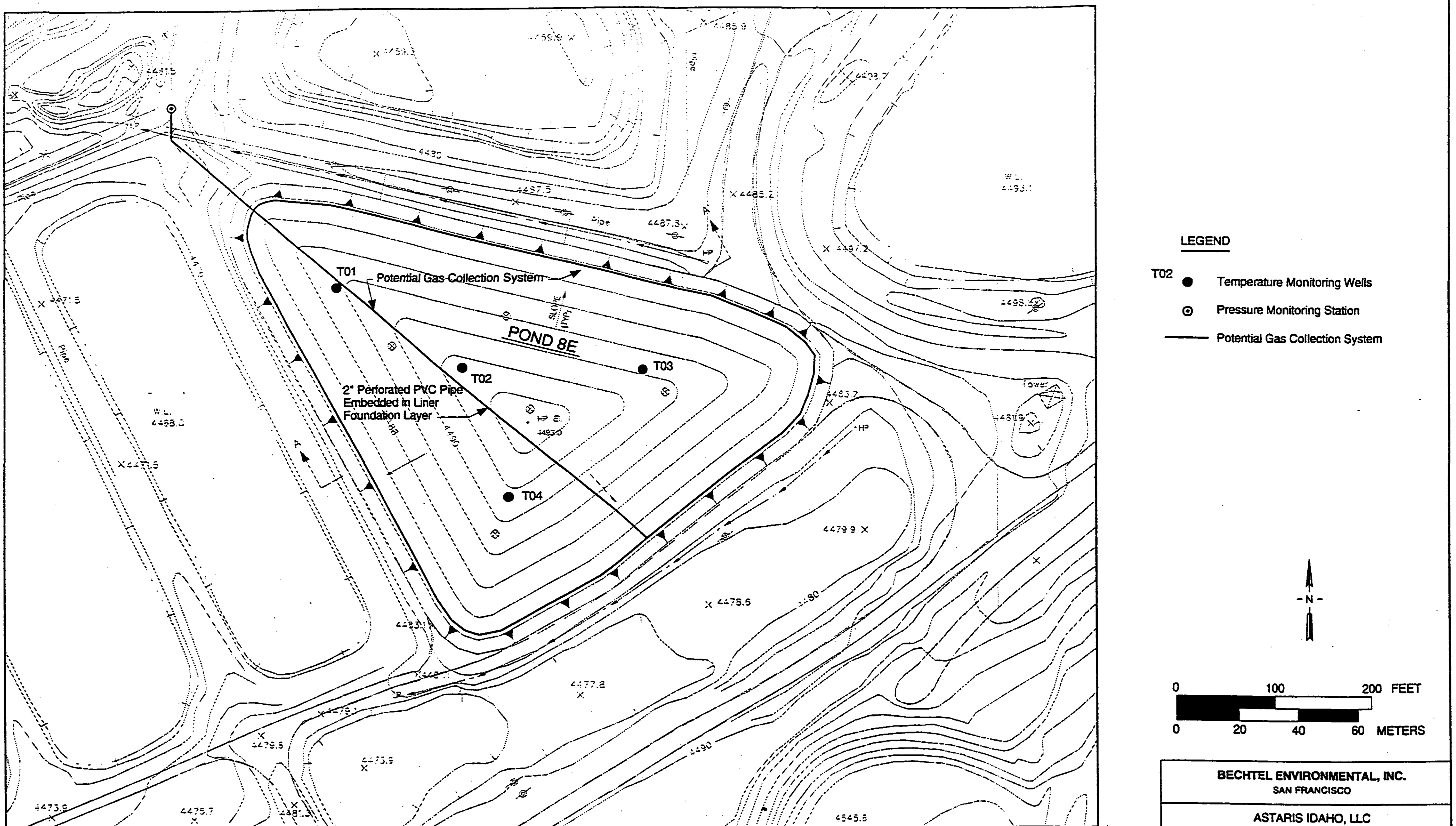
Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.

BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO

FMC CORPORATION
POCATELLO, IDAHO

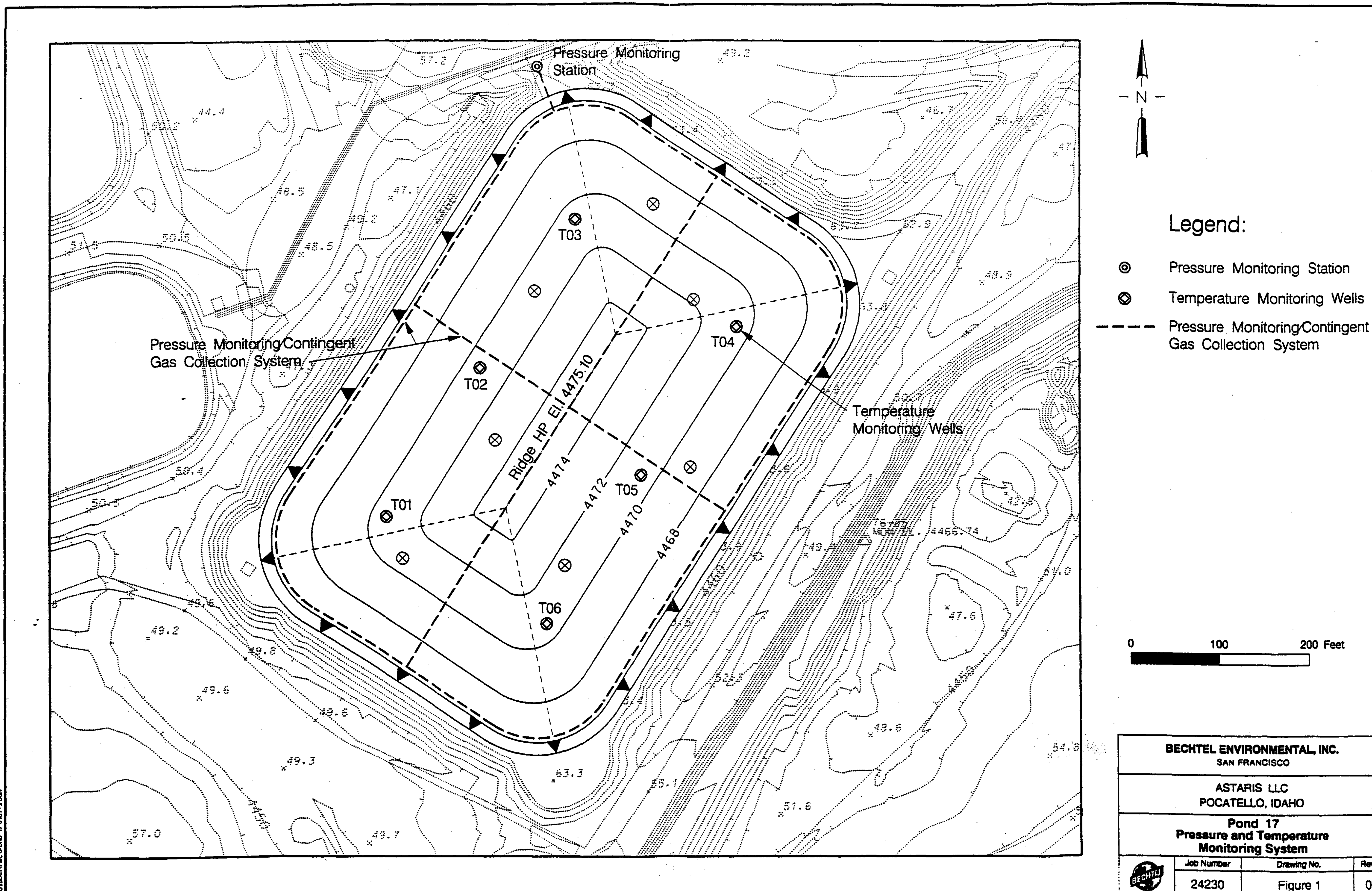
Pond 16S
Pressure and Temperature Monitoring System

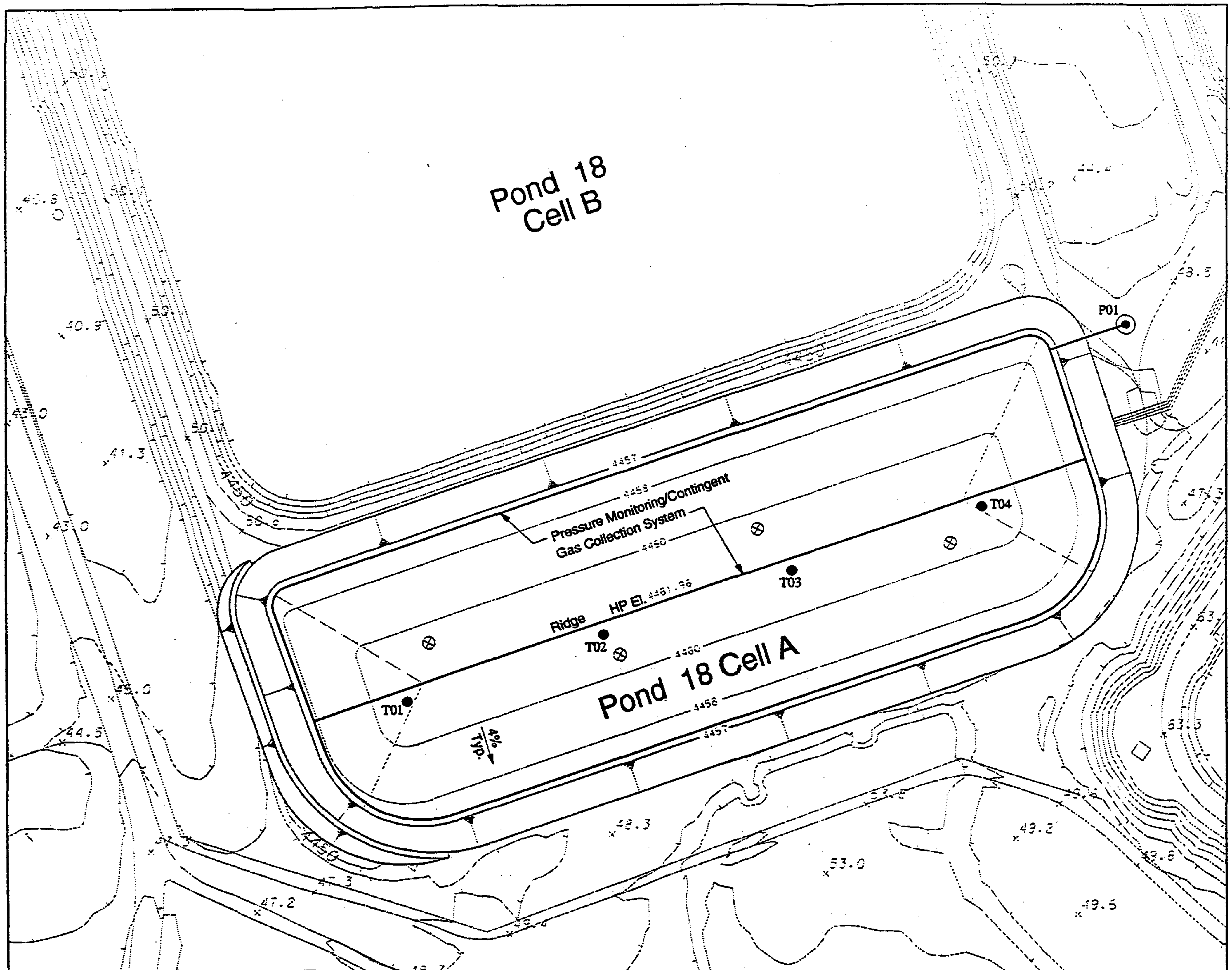
Job Number	Drawing No.	Rev.
20906	Figure 1	0



Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
ASTARIS IDAHO, LLC POCATELLO, IDAHO		
Pond 8E Pressure and Temperature Monitoring System		
Job Number	Drawing No.	Rev.
24230	FIGURE 1	1


Pressure Monitoring Station
T01
T02
T03
T04
T05
T06
Ridge HP El 4475.10
4474
4472
4470
4468
Pressure Monitoring/Contingent Gas Collection System
Temperature Monitoring Wells
N
Legend:
Pressure Monitoring Station
Temperature Monitoring Wells
Pressure Monitoring/Contingent Gas Collection System
0
100
200 Feet
BECHTEL ENVIRONMENTAL, INC.
SAN FRANCISCO
ASTARIS LLC
POCATELLO, IDAHO
Pond 17
Pressure and Temperature
Monitoring System
Job Number
Drawing No.
Rev.
24230
Figure 1
0



Legend

- T01 ● Temperature Monitoring Wells
- P01 ⊙ Pressure Monitoring Station
- —— Pressure Monitoring/Contingent Gas Collection System

0 50 100 150 200 Feet

- N -

Pond 18, Cell A - Plan

Reference: Vertical Datum is Mean Sea Level.
Horizontal Datum is North American Datum 1983.

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
ASTARIS LLC POCATELLO, IDAHO		
Pond 18 Cell A Pressure and Temperature Monitoring System		
Job Number	Drawing No.	Rev.
24230	Figure 1	0

August 2001

11 Closure/Post-closure Cost Estimate

Closure/Post-Closure Cost Estimate

The closure/post-closure cost estimate is described below. This estimate will be reviewed and adjusted for inflation on an annual basis to support financial assurance documents in accordance with 40 C.F.R. §265.142(b) and 40 C.F.R. §265.144(b).

Additionally, if a revision to the Phase IV Ponds Closure Plan or Post-Closure Plan is made that affects this cost estimate, the estimate will be revised in accordance with 40 C.F.R. §265.142(c) and 40 C.F.R. §265.144(c). The cost estimates are kept in the files at the site.

The cost for closing the Phase IV ponds according to the closure activities stated in this closure plan are listed in Table 11-1. The cost estimate includes approximately \$7,029,600 for the closure and \$990,000 for the 30-year post-closure monitoring. The combined dollar amount for the closure and post-closure monitoring is \$8,019,600 as noted in Table 11-1. For costing purposes, the dollar amount for the total sum is stated in 2002 dollars.

The estimated pricing has been developed based upon recent experience at Ponds 8S and 9E, Bechtel Environmental, Inc.'s experience with similar projects, and Means' Heavy Construction Cost Data (Means 2001). The estimate is an order-of-magnitude type, with an accuracy of approximately ±30 percent, and the pricing is based on dollar values for the first quarter of 2002.

TABLE 11-1
PHASE IV PONDS CLOSURE/POST-CLOSURE COST ESTIMATE
FMC, Pocatello, Idaho

CLOSURE COST ESTIMATE		
Cost Code	**Cost Items**	**Total Cost ($)**
	Cap	
1.	Mobilization/Demobilization	214,700
2.	Subgrade Preparation • includes removal of the temporary cover, redistributing of the slag subgrade, capping dewatering piping and system, anchor trench and perimeter subdrain collection piping installation, and 12-inch liner foundation (sand) material	461,400
3.	Geosynthetic Clay Liner • includes installation of 626,000 ft^2 of GCL	414,400
4.	Flexible Membrane Liner • includes installation of 626,000 ft^2 of FML	401,600
5.	Drainage Layer - Geonet/Drainage System • includes 626,000 ft^2 of geonet installation	288,400
6.	Geofabric Filter • includes 626,000 ft^2 of geofabric installation over the geonet drainage layer	152,700
7.	Soil Cover	
	• Sand (12 Inch Thick) Cover Layer	284,100
	• Slag Biointrusion Layer (18 Inch Thick)	367,400
	• Crushed /Screened Slag (6 Inch Thick) Filter Layer	131,400
	• Sand (6 Inch Thick) Filter Layer	131,400
	• Top soil (30 Inch Thick)	681,400
	• Top soil w/15% Pea Gravel (12 Inch Thick)	320,400
8.	Vegetation • includes erosion protection and seeding a total area of 13.2 Acres	25,600
9.	Displacement Monuments and Topsoil Monitors	32,000
10.	Pressure and Temperature Monitoring Systems includes installation of perforated PVC piping, four pressure monitoring station and thirteen temperature monitoring wells	200,800

TABLE 11-1 (Cont)
PHASE IV PONDS CLOSURE/POST-CLOSURE COST ESTIMATE
FMC, Pocatello, Idaho

11.	Cap Infiltration Monitoring System	81,200
12.	Electrical Power Supply for monitoring Systems	85,400
13.	Contingency Gas Treatment System	25,600
14.	Improving Existing Drainage Ditches And Install New Ditches • includes improving 2,110 ft of existing ditches and installation of 2,400 ft of new perimeter ditches and associated culverts	12,800
	SUBTOTAL CONSTRUCTION	**$4,312,700**
15.	Certification	20,000
16.	Construction Management @ ~ 15% of Construction Cost	647,000
17.	Engineering & Procurement @ ~ 10% of Construction Cost	431,000
20.	Contingency @ ~ 30%	1,618,900
	TOTAL CLOSURE COST	**$7,029,600**

TABLE 11-1 (Cont)
PHASE IV PONDS CLOSURE/POST-CLOSURE COST ESTIMATE
FMC, Pocatello, Idaho

POST-CLOSURE COST ESTIMATE		
Cost Code	**Cost Items**	**Total Cost ($)**
1.	**Annual Costs**	
	Inspection • Annual cost for inspection is based on performing 2 inspections each year. Each inspection will have a duration of 2 days. The cost also includes an allowance for inspection after major storm events.	**3,200**
	Displacement monitoring • Annual cost for displacement monitoring is based on a survey crew performing an annual survey of each settlement monuments, including data preparation and summary.	**3,200**
	Groundwater monitoring • Annual cost for groundwater monitoring is based on performing quarterly monitoring events. Each event will be consisting of a 1-man crew performing about 1/2 day of water sample collection, and the costs for laboratory analysis, data management, and reporting. The cost is also assumed to be shared with the Pond 8E as they have common monitoring wells.	**7,900**
	Cap maintenance and storm water management maintenance • Annual cost of maintenance activities for final cap, monitoring and security systems, includes labor and equipment for one week, and an allowance for materials. The cost also includes engineer's inspection and reporting of the maintenance activities.	**16,000**
	Temperature and pressure monitoring • Annual cost for temperature and pressure monitoring is based on performing quarterly monitoring events.	**1,100**

CONFIDENTIAL BUSINESS INFORMATION

TABLE 11-1 (Cont)
PHASE IV PONDS CLOSURE/POST-CLOSURE COST ESTIMATE
FMC, Pocatello, Idaho

POST-CLOSURE COST ESTIMATE		
Cost Code	**Cost Items**	**Total Cost ($)**
	Contingency gas treatment system operation and maintenance • Annual cost includes quarterly inspections and maintenance and annual operation.	**1,600**
	Annual Cost **Period (years) = 30**	**33,000**
	TOTAL POST-CLOSURE COST	**$990,000**
TOTAL COMBINED CLOSURE AND POST-CLOSURE COSTS		**$8,019,600**

Financial Assurance

This closure plan has been developed to meet RCRA requirements for closure of the Phase IV ponds at FMC Idaho, LLC (FMC). A financial assurance mechanism to cover the cost of closure for all the waste management units has been established by FMC to meet the requirements of RCRA regulations at 40 C.F.R. Part §265.143. The financial mechanism is a Standby Trust Agreement and four bank letters of credit including the March 21, 2001 Amendment which meets the requirements of 40 C.F.R. §265.143. The cost estimate for closure in place of the Phase IV ponds, included in this closure plan, is $7,029,600. The Phase IV ponds post-closure monitoring cost estimate is $990,000.

The combined dollar amount for the closure and post-closure monitoring of the Phase IV ponds is $8,019,000. The Trust Agreement/Standby Trust, Schedule A for the entire plant is in the amount of $87,575,200. The documentation for the updated estimate for the entire plant, including the Phase IV ponds, is included in this section.

FMC will adjust the financial assurance mechanism annually and within 60 days of any changes that may occur in the closure cost estimate. Future amendments will be kept in the Operating Record at the Pocatello plant.

Within 60 days after receiving certification from FMC and an independent Professional Engineer registered in the state of Idaho that the closure has been completed in accordance with the approved Closure Plan, EPA will notify FMC in writing that financial assurance for closure of the specific unit is no longer required.

TRUST AGREEMENT/STANDBY TRUST

SCHEDULE A

This Agreement demonstrates financial assurance for the following cost estimate(s) for the following facility(ies):

Hazardous Waste Facility Identification Number	Name of Facility	Address of Facility	Cost Estimates for Which Financial Assurance Being Demonstrated by This Agreement
IDD070929518	FMC Corporation Phosphorus Chemicals Division	Highway 30 West Pocatello, ID. 83201	Closure:$78,380,900.00 Post-Closure: $ 9,194,300.00 Total $87,575,200.00

The cost estimate(s) listed here were last adjusted on March, 2001.

This amount is covered by Letters of Credit issued by Bank of America, Bank of New York, Bank One and Cariplo Bank, broken down as follows:

Bank	Closure	Post-Closure	Total
Bank of America	$33,113,510.00	$7,021,390.00	$40,134,900.00
Bank of New York	$14,620,090.00	$1,443,510.00	$16,063,600.00
Bank One	$20,000,000.00		$20,000,000.00
Banca Intesa (Cariplo Bk)	$10,647,300.00	$729,400.00	$11,376,700.00
Total	$78,380,900.00	$9.194,300.00	$87,575,200.00

CONFIDENTIAL BUSINESS INFORMATION

EPAUPDATE-3

Bank of America

DATE: MARCH 21, 2001

AMENDMENT TO IRREVOCABLE STANDBY CREDIT NUMBER: 7220699
APPLICANT REFERENCE NUMBER: 88017000

AMENDMENT NUMBER 10

BENEFICIARY	APPLICANT
REGIONAL ADMINISTRATOR - REGION X	FMC CORPORATION
U.S. ENVIRONMENTAL PROTECTION	CHEMICAL TECHNOLOGY DIVISION
AGENCY, 1600 - 6TH AVE.	200 E. RANDOLPH DR. - REF: 88017000
SEATTLE, WA 98101	CHICAGO, IL 60601

THIS AMENDMENT IS TO BE CONSIDERED AN INTEGRAL PART OF THE ABOVE CREDIT AND MUST BE ATTACHED THERETO.

THE ABOVE MENTIONED CREDIT IS AMENDED AS FOLLOWS:

THE AMOUNT OF THIS CREDIT HAS BEEN INCREASED BY USD 3,622,900.00
THE AGGREGATE AMOUNT OF THE CREDIT IS NOW USD 40,134,900.00

INCREASE IS BASED ON THE FOLLOWING CHANGES:

EPA#	YEAR	CLOSURE	POST-CLOSURE	TOTAL
IDD070929518	2001	$33,113,510.00	$7,021,390.00	$40,134,900.00
	2000	29,869,800.00	6,642,200.00	36,512,000.00
TOTAL 2001 INCREASE		$ 3,243,710.00	379,190.00	3,622,900.00

SEE ATTACHED FOR FURTHER EXPLANATION

ALL OTHER TERMS AND CONDITIONS REMAIN UNCHANGED.

IF YOU REQUIRE ANY ASSISTANCE OR HAVE ANY QUESTIONS REGARDING THIS AMENDMENT, PLEASE CALL 312-923-5949.

(8840)

AUTHORIZED SIGNATURE AUTHORIZED SIGNATURE

THIS DOCUMENT CONSISTS OF 1 PAGE(S).

CONFIDENTIAL BUSINESS INFORMATION

FROM BNY STANDBY SECTION

THE BANK OF NEW YORK LETTER OF CREDIT DEPARTMENT
CHURCH ST. STATION
P.O. BOX 11238
NEW YORK, N.Y. 10286-1238

OUR. NO.
S00037649

CORRESPONDENT'S REF. NO.

DATE
MARCH 10 1999

BENEFICIARY:
REGIONAL ADMINISTRATOR
ENVIRONMENTAL PROTECTION AGENCY
REGION X, 1200 - 6TH AVENUE
SEATTLE, WA 98101

APPLICANT:
FMC CORPORATION
ENVIRONMENTAL SERVICES DIVISION
200 E. RANDOLPH DRIVE
CHICAGO, IL 60601

DATE OF ORIGINAL ISSUE:
JUNE 18 1998

AMENDMENT DATE:
MARCH 10 1999

GENTLEMEN/LADIES:

THE ABOVE MENTIONED INSTRUMENT INCLUDING ANY PREVIOUS AMENDMENTS,
IS AMENDED AS FOLLOWS:
CREDIT AMOUNT INCREASED BY ***USD32,700.00***
NEW CREDIT AMOUNT TOTAL ***USD16,063,600.00***

IF THIS AMENDMENT IS TO BE REJECTED,
BENEFICIARY'S SIGNED STATEMENT TO THAT EFFECT IS
REQUIRED.

ALL OTHER TERMS AND CONDITIONS REMAIN UNCHANGED.
THIS AMENDMENT IS TO BE CONSIDERED AS PART OF THE
ABOVE CREDIT AND MUST BE ATTACHED THERETO.

ALL OTHER CONDITIONS REMAIN UNCHANGED.

YOURS VERY TRULY,

AUTHORIZED SIGNATURE

CONFIDENTIAL BUSINESS INFORMATION

NON-NEGOTIABLE COPY

BANK ONE

GLOBAL TRADE SERVICES
MAIL CODE IL 1-0236
CHICAGO, ILLINOIS 60670-0236 U.S.A.
Telex: ITT 4330253 FNBCUI Swift Address: FNBCUS44
TEL: (312) 954-1969 FAX: (312) 954-1963

THIS IS THE DUPLICATE COPY OF ORIGINAL LETTER OF CREDIT WHICH WAS ISSUED ON AUGUST 10, 1999. THIS COPY IS AVAILABLE FOR DRAWING ONLY WHEN THE ORIGINAL ONE IS DECLARED LOST BY THE BENEFICIARY.

IRREVOCABLE STANDBY LETTER OF CREDIT

REGIONAL ADMINISTRATOR
REGION 10
U.S. ENVIRONMENTAL PROTECTION AGENCY
1200 - 6TH AVENUE
SEATTLE, WA 98101-1128

EPA ID# IDD 070929518

RE: IRREVOCABLE STANDBY LETTER OF CREDIT NO. 00521265

DEAR SIR/MADAM:

WE HEREBY ESTABLISH OUR IRREVOCABLE STANDBY LETTER OF CREDIT NO. 00321265 IN YOUR FAVOR, AT THE REQUEST AND FOR THE ACCOUNT OF FMC CORPORATION, 200 E. RANDOLPH DRIVE, CHICAGO, ILLINOIS 60601 (REF: 9899.1004-EPD) UP TO THE AGGREGATE AMOUNT OF U.S.$20,000,000.00 (TWENTY MILLION AND NO/100 U.S. DOLLARS) AVAILABLE UPON PRESENTATION BY YOU OF:

1) YOUR SIGHT DRAFT BEARING REFERENCE TO THIS LETTER OF CREDIT NO. 00321265.

2) YOUR SIGNED STATEMENT READING AS FOLLOWS: "I CERTIFY THAT THE AMOUNT OF THE DRAFT IS PAYABLE PURSUANT TO REGULATIONS ISSUED UNDER AUTHORITY OF THE RESOURCE CONSERVATION AND RECOVERY ACT OF 1976 AS AMENDED."

3) YOUR SIGNED AND DATED STATEMENT READING AS FOLLOWS: "THE ORIGINAL LETTER OF CREDIT NUMBER 00321265 ISSUED BY BANK ONE, NA, CHICAGO, ILLINOIS (FORMERLY THE FIRST NATIONAL BANK OF CHICAGO) ON AUGUST 10, 1999 HAS BEEN LOST AND WE ARE NOT ENTITLED TO CLAIM ANY DRAWINGS UNDER THE LOST ORIGINAL LETTER OF CREDIT."

THIS LETTER OF CREDIT IS EFFECTIVE AS OF AUGUST 10, 1999 AND SHALL EXPIRE ON AUGUST 10, 2000, BUT SUCH EXPIRATION DATE SHALL BE AUTOMATICALLY EXTENDED FOR A PERIOD OF ONE YEAR ON AUGUST 10, 2000 AND ON EACH SUCCESSIVE EXPIRATION DATE, UNLESS AT LEAST 120 DAYS BEFORE THE CURRENT EXPIRATION DATE, WE NOTIFY BOTH YOU AND FMC CORPORATION BY CERTIFIED MAIL THAT WE HAVE DECIDED NOT TO EXTEND THIS LETTER OF CREDIT BEYOND THE CURRENT EXPIRATION DATE. IN THE EVENT YOU ARE SO NOTIFIED, ANY UNUSED PORTION OF THE CREDIT SHALL BE AVAILABLE UPON PRESENTATION OF YOUR SIGHT DRAFT FOR 120 DAYS AFTER DATE OF RECEIPT BY BOTH YOU AND FMC CORPORATION, AS SHOWN ON THE SIGNED RETURN RECEIPTS.

WHENEVER THIS LETTER OF CREDIT IS DRAWN ON UNDER AND IN COMPLIANCE WITH THE TERMS OF THIS CREDIT, WE SHALL DULY HONOR SUCH DRAFT UPON PRESENTATION TO US, AND WE SHALL DEPOSIT THE AMOUNT OF THE DRAFT DIRECTLY INTO THE STANDBY TRUST FUND OF FMC CORPORATION IN ACCORDANCE WITH YOUR INSTRUCTIONS.

(CONTINUED)

BANK ONE

GLOBAL TRADE SERVICES
MAIL CODE IL 1-0236
CHICAGO, ILLINOIS 60670-0236 U.S.A.
Telex: ITT 4330253 FNBCUI Swift Address: FNBCUS44
TEL: (312) 954-1969 FAX: (312) 954-1963

WE CERTIFY THAT THE WORDING OF THIS LETTER OF CREDIT IS IDENTICAL TO THE WORDING SPECIFIED IN 40 CFR 264.151 (D), AS SUCH REGULATIONS WERE CONSTITUTED ON THE DATE SHOWN IMMEDIATELY BELOW.

AUTHORIZED SIGNER/TITLE

#9960
AUTHORIZED SIGNER/TITLE

DATE: AUGUST 10, 1999

THIS CREDIT IS SUBJECT TO THE UNIFORM CUSTOMS AND PRACTICE FOR DOCUMENTARY CREDITS (1993 REVISION), INTERNATIONAL CHAMBER OF COMMERCE PUBLICATION NO.500.

CONFIDENTIAL BUSINESS INFORMATION

FILE COPY

GLOBAL
MAIL CODE IL 1-0236
CHICAGO, ILLINOIS 60670-0236 U.S.A.
Telex: ITT 4330253 FNBCUI Swift Address: FNBCUS44
TEL: (312) 854-1060 FAX: (312) 854-1863

OUTSIDE OF THIS CREDIT, WE ARE INFORMED BY THE APPLICANT THAT THERE ARE THREE LETTERS OF CREDIT PROVIDING COVERAGE FOR THE FINANCIAL ASSURANCE UNDER EPA ID #IDD 070929518. THE LETTERS OF CREDIT ARE LISTED BELOW. UPON ACCEPTANCE OF THIS NEW LETTER OF CREDIT, BANK OF AMERICA'S LETTER OF CREDIT NO. 7220699 WILL BE REDUCED BY $20,000,000.00. THIS REDUCTION WILL BE REQUESTED BY AMENDMENT.

BANK OF AMERICA L/C NO. 7220699	$56,512,000.00 (UPON ACCEPTANCE, THIS L/C WILL BE REDUCED)
BANK OF NEW YORK L/C NO. 003764-9	$16,030,900.00
WACHOVIA BANK L/C NO. 870-106752	$11,376,700.00
BANK ONE, NA, CHICAGO, ILLINOIS L/C NO. 00321265	$20,000,000.00
TOTAL COVERAGE WILL REMAIN	$83,919,600.00

CONFIDENTIAL BUSINESS INFORMATION

FILE COPY

AMENDMENT

DATE: March 8, 2000

MAIL

[redacted]

REGIONAL ADMINISTRATOR
REGION 10
US ENVIRONMENTAL PROTECTION AGENCY
1200 - 6TH AVENUE
SEATTLE, WA 98101

Gentlemen:

We are instructed by :

FMC CORPORATION
200 EAST RANDOLPH DRIVE
EXPORT FIN.
ATTN: MARGARET LAVERY
CHICAGO, IL 60601

to amend credit 00321265 as issued in your favor.

This amendment is an integral part of the original credit.
All other terms and conditions of the letter of credit including
previous amendments remain unchanged.

Amended terms:

Expiration date: August 10, 2001 current expiration date.

IN HOUSE AMENDMENT TO AUTO EXTEND L/C TO EXPIRY OF 08/10/01. NEXT
HAZ DATE 03/31/00.

Yours very truly

Preparer/Authorized Signer

Authorized Signer

CONFIDENTIAL BUSINESS INFORMATION

CARIPLO BANK
CARIPLO-CASSA DI RISPARMIO DELLE PROVINCIE LOMBARDE S.p.A.

NEW YORK BRANCH
10 EAST 53rd STREET
NEW YORK, NY 10022
TEL (212) 832-6622
FAX (212) 527-8777

Irrevocable Standby Letter of Credit No. 10172
Amount **US$11,376,700.00**
Date August 4, 2000

Regional Administrator
U.S. Environmental Protection Agency
Region 10
1200 6th Avenue
Seattle, WA 98101-1128

Applicant: FMC Corporation
Environmental Services Division
200 E. Randolph Drive
Chicago, IL 60601
REF: 9899.1004-EPD

Amount: Exactly USD 11,376,700.00
Exactly Eleven Million Three Hundred Seventy Six Thousand Seven Hundred and no/100 U.S. Dollars

Expiration: August 4, 2001 or any Further Extended Date as Provided Herein at Our Counters for Payment

Dear Sirs:

We hereby establish our Irrevocable Standby Letter of Credit No. 10172 in your favor, at the request and for the account of FMC Corporation, 200 E. Randolph Drive, Chicago, Illinois 60601 (REF: 9899.1004 EPD) up to the aggregate amount of U.S. $11,376,700.00 (Eleven Million Three Hundred Seventy Six Thousand Seven Hundred and no/100 U.S. Dollars) available upon presentation by you of:

1.) Your sight draft bearing reference to this Letter of Credit No. 10172.

2.) Your signed statement reading as follows:

"I certify that the amount of the draft is payable pursuant to regulations issued under authority of the Resource Conservation and Recovery Act of 1976 as amended."

This Letter of Credit is effective immediately and shall expire on August 4, 2001, but such expiration date shall be automatically extended for a period of one year on August 4, 2001, and on each successive expiration date, unless at least 120 days before the current expiration date, we notify both you and

CONFIDENTIAL BUSINESS INFORMATION

CARIPLO BANK
NEW YORK BRANCH

FMC Corporation by certified mail that we have decided not to extend this Letter of Credit beyond the current expiration date. In the event you are so notified, any unused portion of the credit shall be available upon presentation of your sight draft to us up to the then current expiration date.

Whenever this Letter of Credit is drawn on, under and in compliance with the terms of this Credit, we shall duly honor such draft upon presentation to us, and we shall deposit the amount of the draft directly into the Standby Trust Fund of FMC Corporation in accordance with your instructions.

We certify that the wording of this Letter of Credit is identical to the wording specified in 40 CFR 264.151 (d), as such regulations were constituted on the date shown immediately below.

Authorized Signature	Authorized Signature
R. DeLuca	A. Fantino
Assistant Treasurer	Vice President

Outside of this Credit, we are informed by the Applicant that this L/C will replace L/C No. 870-106752, issued by Wachovia Bank. Wachovia Bank has notified the Regional Administrator that their document will expire November 23, 2000 and do not want to renew it. We are also advised that there are four L/C's providing coverage for the Financial Assurance under EPA ID# IDD 070929518. The L/C's are listed below.

Bank of America L/C 7220699	$56,512,000.00	(upon acceptance of amendment by Beneficiary this L/C will be reduced to $36,512,000.00)
Bank of New York L/C 003764-9	$16,030,900.00	
Bank One (formerly First Chicago NBD)	$20,000,000.00	
Cariplo Bank (New L/C)	$11,376,700.00	

Total Coverage will remain $83,919,600.00 (after reduction).

CARIPLO BANK
CARIPLO-CASSA DI RISPARMIO DELLE PROVINCIE LOMBARDE S.p.A.

NEW YORK BRANCH
10 EAST 53rd STREET
NEW YORK, NY 10022
TEL (212) 832-6622
FAX (212) 527-8777

Amendment No. 1 To
Irrevocable Standby
Letter of Credit No.10172
Amount: **US$11,376,700.00**
Expiring: August 04, 2001

October 18,2000

Regional Administrator
U.S. Environmental Protection Agency
Region 10
1200 6th Avenue
Seattle, WA 98101-1128

For account of: FMC Corporation
Environmental Services Div.
200 E. Randolph Drive
Chicago, IL 60601
Ref: 9899.1004-EPD

Gentlemen:

This Irrevocable Standby Letter of Credit is hereby amended as follows:

Delete all reference to the Bank Name(s) as presently shown in this Standby Letter of Credit as:

Cariplo Bank New York Branch and/or
Cariplo Bank - Cassa Di Risparmio Delle Provincie
Lombarde S.p.A. New York Branch

Replace with the following Bank Name:

Banca Intesa S.p.A. New York Branch
(Please See Attachment)

All other terms and conditions remain unchanged.

Very truly yours,

R. De Luca
Authorized Signature

Authorized Signature

CONFIDENTIAL BUSINESS INFORMATION

Part of Group Intesa

TAB

Section 13

References

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13 References

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Section 14

CLOSURE/POST-CLOSURE PLAN CHECKLIST

Facility Name: FMC, Pocatello, Idaho
ID No.: IDD 070929518

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
I.	**General Closure Requirements**			
A.	Partial and/or Final Closure			
A-1.	Closure performance standards [§265.111]	Y	6.2.2	
A-2.	Closure plan contents[§265.112(b)]	Y	2.4	
A-2a.	Description of unit closure [§265.112(b)(1)]	Y	6.1, 7.1	
A-2b.	Description of facility closure [§265.112(b)(2)]	N/A		
A-2c.	Maximum inventory of wastes [§265.112(b)(3)]	Y	3.3	
A-2d.	Removal/decontamination procedures [§265.112(b)(4)]	Y	6.3, 8.2, 8.3, 8.4, 8.5	
A-2e.	Other activities during closure period [§265.112(b)(5)]	Y	4, 8.6, 8.7, 8.8, 8.9, 8.10	
A-2f.	Closure schedule for each unit/final closure [§265.112(b)(6)]	Y	6.6	
A-2g.	Year of final closure [§265.112(b)(7)]	N/A		
A-3.	Amendment of closure plan [§265.112(c)]	Y	6.7	
A-4.	Notification of partial and final closure [§265.112(d)]	Y	8.12, 10.1	
B.	Time Allowed for Closure			
B-1.	Extension of closure time frames [§265.113(a) and (b)]	Y	6.6, 6.6.1	
B-2.	Time frames for demonstrations for extensions [§265.113(c)]	Y	6.6, 6.6.1	
C.	Disposal or Decontamination of Equipment, Structures and Soils [§265.114]	Y	6.3, 8.2, 8.3, 8.4, 8.5, 8.10	
D.	Certification of Closure [§265.115]	Y	8.11, 9	

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
E.	Survey Plat and Certification by Professional Land Surveyor [§265.116]	Y	8.11	
F.	Closure Cost Estimate	Y	11	
F-1.	Written closure cost estimate [§265.142(a)]	Y	11	
F-2.	Adjustments to closure cost estimates [§265.142(b)&(c)]	Y	11	
F-3.	Keep cost estimate at facility [§265.142(d)]	Y	10.11, 11	
G.	Financial Assurance for Closure [§265.143]	Y	12	
H.	Liability Coverage [§265.147]	NA		Liability coverage is in effect for the entire plant and is addressed in Section I (Vol. 22.1) of the facility's RCRA Part B permit application.

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
II.	**General Post-Closure Requirements**			
A.	Post-closure Care and Use of Property [§265.117]			
A-1.	Post-closure care period and requirements [§265.117(a)(1)]	Y	10	
A-2.	Increasing/decreasing length of post-closure period [§§265.117(a)(2)]	Y	10	
A-3.	Property use restrictions [§265.117(c)]	Y	10.1	
B.	Post-closure Plan			
B.1.	Submittal of Post-closure Plan [§265.118(a)]	Y	10	
B-2.	Availability of Post-closure Plan [§265.118(b)]	Y	10	
B-3.	Monitoring activities described [§265.118(c)(1)]	Y	4, 10.3, 10.4, 10.5, 10.8, 10.9, 10.10	
B-4.	Maintenance activities described [§265.118(c)(2)]	Y	Fig. 10-1, 10.3, 10.6, 10.7	
B-5.	Post-closure contact identified [§265.118(c)(3)]	Y	10	
C.	Amendment of Post-closure Plan [§265.118(d) and (g)]	Y	10	
D.	Post-closure Notices [§265.119]			
D-1.	Notice to local zoning authority/record of wastes [§265.119(a)]	Y	10, 10.1	
D-2.	Notice in deed [§265.119(b)(1)]	Y	10, 10.1	
D-3.	Certification of notice [§265.119(b)(2)]	Y	10, 10.1	
D-4.	Removal of wastes from a closed unit [§265.119(c)]	N/A		No wastes are planned for removal after completion of closure.
E.	Certifications of Completion of Post-closure Care [§265.120]	Y	10.1	

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
F.	Post-closure Care Cost Estimate [§265.144]	Y	11	
F-1.	Written Post-closure Estimate [§265.144(a)]	Y	11	
F-2.	Adjustments to post-closure care cost estimates [§265.144(b)]	Y	11	
F-3.	Revisions to post-closure care cost estimates [§265.144(c)]	Y	11	
F-4.	Keep estimate at facility [§265.144(d)]	Y	10.11, 11	
G.	Financial Assurance for Post-closure Care [§265.145]	Y	12	

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
III.	**Closure of Surface Impoundments**			
A.	Closure Requirements [§265.228]			
A-1.	Closure by waste removal [§265.228(a)(1))]	N/A		Waste will not be removed. Ponds will be closed with waste in place.
A-2.	Closure with waste in place [§265.228(a)(2)]	Y	6.1	
A-3.	Eliminate Free Liquids [§265.228(a)(2)(i)]	Y	7.2.1, 8.2	
A-4.	Stabilize Wastes to Support Final Cover [§265.228(a)(2)(ii)]	Y	7.2, 8.6	
B	Final Cover Design and Construction [§265.228(a)(2)(iii)]			
B-1.	Minimization of liquid migration [§265.228(a)(2)(iii)(A)]	Y	6.2, 7	
B-2.	Function with minimum maintenance [§265.228(a)(2)(iii)(B)]	Y	6.2, 7	
B-3.	Promotion of drainage and minimization of erosion or abrasion [§265.228(a)(2)(iii)(C)]	Y	6.2, 7.3, 7.4, 7.5, 7.6, 7.7	
B-4.	Accommodate settling and subsidence [§265.228(a)(2)(iii)(D)]	Y	6.2, 7.4, 7.5, 8.6, 8.7	
B-5.	Permeability standard [§265.228(a)(2)(iii)(E)]	Y	6.2, 7.1, 7.2	
C.	Post-closure care requirements [§265.228(b)]			
C-1.	Inspection and maintenance of final cover [§265.228(b)(1)]	Y	10.3, 10.4, 10.6, 10.7	
C-2.	Maintenance and monitoring of leak detection system [§265.228(b)(2)]	N/A		Phase IV ponds do not have a functional LDCRS
C-3.	Maintenance and monitoring of the groundwater monitoring system [§265.228(b)(3)]	Y	10, 10.3, 10.5	
C-4.	Erosion prevention [§265.228(b)(4)]	Y	7.6, 10.3, 10.6, 10.7	

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
IV.	**Closure of Landfills**			
A.	Final Cover Design and Construction [§265.310 (a)]			
A-1.	Minimization of liquid migration [§265.310(a)(1)]	Y	6.2, 7	
A-2.	Function with minimum maintenance [§265.310(a)(2)]	Y	6.2, 7	
A-3.	Promotion of drainage and minimization of erosion or abrasion [§265.310(a)(3)]	Y	6.2, 7.3, 7.4, 7.5, 7.6, 7.7	
A-4.	Accommodate settling and subsidence [§265.310(a)(4)]	Y	6.2, 7.4, 7.5, 8.6, 8.7	
A-5.	Permeability standard [§265.310(a)(5)]	Y	6.2, 7.1, 7.2	
B.	Post-closure Care Requirements [§265.310(b)]			
B-1.	Inspection and maintenance of the final cover [§265.310(b)(1)]	Y	10.3, 10.4, 10.6, 10.7	
B-2.	Maintenance and monitoring of leak detection system [§265.310(b)(2)]	Y	8.9, 10.3	
B-3.	Inspection and maintenance of the groundwater monitoring system [§265.310(b)(3)]	Y	10.3, 10.5	
B-4.	Run-on and run-off prevention [§265.310(b)(4)]	Y	7.6, 10.3, 10.7	
B-5.	Maintenance of surveyed benchmarks [§265.310(b)(5)]	Y	10.1, 10.3	
B-6.	Gas ventilation system, if applicable [§265.310(b)(1)]	NA	7.1.4, 10.8	

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
V.	**Groundwater Monitoring Program**			
A	Monitoring system	Y	4, 5	(Reference Notes 1 and 2)
A-1.	Monitoring well locations [§265.91(a)and(b)]	Y	4.1, 5	
A-1.	Monitoring well construction [§265.91(c)]	Y	4.1,	(Reference Note 1)
B.	Sampling and analysis [§265.92]	Y	4.2	(Reference Note 1)
B-1.	Sampling plan [§265.92(a)]	Y	4.2, Att 1 of Sec 10	(Reference Note 1)
B-2.	Analytical parameters [§265.92(b)]	Y	4.2, 5, 10.5	(Reference Note 1)
B-3.	Establishment of background values [§265.92(c)]	Y	5	(Reference Note 1)
B-4.	Annual and semiannual determinations [§265.92(d)]	Y	5	(Reference Note 1)
B-5e.	Groundwater levels [§265.92(e)]	Y	4, 5	(Reference Note 1)
C.	Preparation, evaluation, and response [§265.93]	Y	4, 5	(Reference Note 1)
C-1.	Groundwater quality assessment program [§265.93(a)]	Y	4, 5	(Reference Note 1)
C-2.	Statistical comparisons [§265.93(b)]	Y	4.2, 5	(Reference Note 1)

Note 1: The groundwater monitoring program for Pond 15S is part of a single comprehensive RCRA/CERCLA Program being conducted at the FMC plant. Therefore, several of the checklist items in this section are not specifically addressed in the Pond 15S Closure Plan. Compliance with these items is addressed as part of an EMF site wide program in accordance with EPA Region 10 Memorandum of Understanding and subsequent communications with EPA Region 10 RCRA program personnel regarding the interface between RCRA and CERCLA groundwater monitoring at the EMF site (Appendix C).

Note 2: In accordance with 42 USC 6925(i) and 40 C.F.R. 270.1(c), groundwater monitoring associated with post-closure care must also meet the applicable 40 C.F.R. 264, Subpart F regulations for permitted units. These regulations have also been considered in preparation of this Closure Plan and the plant's Part B permit application (FMC, 1991).

RCRA (40 C.F.R. PART 265) Closure/Post-closure Plans

		Provided (Y/N) or NA	Location (Section)	Comments
C-3.	Reporting and confirmation sampling [§265.93(c)]	Y	4.2	(Reference Note 1)
C-4.	Detailed assessment program [§265.93(d)]			
	• assessment plan [§265.93(d)(2) and (3)]	Y	5	(Reference Note 1)
	• implementation [§265.93(d)(4) and (4)]	Y	5	(Reference Note 1)
	• reinstate indicator evaluation program [§265.93(d)(6)]	Y	5	(Reference Note 1)
	• cessation of assessment program [§265.93(d)(7)]	Y	5	(Reference Note 1)
C-5.	Data Evaluation [§265.93(f)]	Y		(Reference Note 1)
D.	Required records and reporting [§265.94]	Y	4.2	(Reference Note 1)

Note 1: The groundwater monitoring program for Pond 15S is part of a single comprehensive RCRA/CERCLA Program being conducted at the FMC plant. Therefore, several of the checklist items in this section are not specifically addressed in the Pond 15S Closure Plan. Compliance with these items is addressed as part of an EMF site wide program in accordance with EPA Region 10 Memorandum of Understanding and subsequent communications with EPA Region 10 RCRA program personnel regarding the interface between RCRA and CERCLA groundwater monitoring at the EMF site (Appendix C).

Note 2: In accordance with 42 USC 6925(i) and 40 C.F.R. 270.1(c), groundwater monitoring associated with post-closure care must also meet the applicable 40 C.F.R. 264, Subpart F regulations for permitted units. These regulations have also been considered in preparation of this Closure Plan and the plant's Part B permit application (FMC, 1991).

Appendix A

APPENDIX A

GEOLOGIC DRILL LOGS

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	1 OF 2	104

SITE	COORDINATES and/or STATIONINGS	ANGLE FROM HORIZ	BEARING
NE of Ponds 8E and 11S-14S	N 450,145.9 E 554,270.2	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
11-7-90	11-7-90	Layne Environmental	AP-1000	10"	110.0	0.0	110.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/		0	4486.71	4484.6	86.6/4398.1 12-01-90 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
No samples collected.	4-in / 109-ft	Curtis Obi

SAMP. TYPE AND DIAM. | SAMP. ADV. LEN CORE | SAMPLE REC. CORE REC. | SAMPLE BLOWS "N" % CORE RECOVERY | WATER PRESSURE TESTS: LOSS IN G.P.M, PRESS. P.S.I., TIME IN MIN. | ELEV. | DEPTH | GRAPHICS | SAMPLE

(Template: BCHTLLS)

DESCRIPTION AND CLASSIFICATION

ELEV.	DEPTH	DESCRIPTION
4484.6	0	0 - 14 ft. SAND (SP): Moderate yellowish brown (10 YR 5/4) to dark yellowish brown (10 YR 4/2), dry, fine-grained sand with 20-40% subangular-to-subrounded gravel and cobbles (diameter ≤ 4 in.).
4470.6	14	14 - 43 ft. SILT (ML): Moderate yellowish brown (10 YR 5/4) to dark yellowish orange (10 YR 6/6), dry.
4441.6	43	43 - 49 ft. SAND WITH GRAVEL (SP): Moderate yellowish brown (10 YR 5/4), dry, fine-grained sand with 20-40% subangular-to-subrounded well-graded gravel and cobbles (diameter ≤ 6 in.) of quartz, quartzite, and mafic lithologies, and 10% medium to coarse-grained sand.
4435.6	49	49 - 89 ft. SILT WITH GRAVEL (ML): Dark yellowish orange (10 YR 6/6), dry, with 5-30% subrounded gravel (diameter ≤ 1 in.), 10% fine-grained sand.

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

Dual-wall percussion drilling with reverse air circulation.

Air-water mist (<1 gpm) used where needed to restore circulation.

Logged from drill cuttings and from split-spoon samples using the Unified Soil Classification System (ASTM D 2488-84) and the GSA Rock Color Chart.

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	2 OF 2	104

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							4395.6	89			89 - 110 ft. <u>SILTY GRAVEL WITH SAND (GM)</u>: Moderate yellowish brown (10 YR 5/4), wet, subangular-to-subrounded gravel and cobbles (diameter ≤ 5 in.) of volcanic lithologies, 20% well-graded sand, 20% silt.	Encountered ground water during drilling at approximately 87 ft below the ground surface.
							4374.6	110			TOTAL DEPTH: 110 FT.	Boring converted to well on 9-28-90.

Depth scale: 75, 80, 85, 90, 95, 100, 105, 110

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE	Last Update:	HOLE NO.
NE of Ponds 8E and 11S-14S	8-12-92	104

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	1 OF 2	114

SITE	COORDINATES and/or STATIONINGS	ANGLE FROM HORIZ	BEARING
Northeast of Pond 15S	N 449,848.7 E 553,029.9	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-16-90	10-16-90	Layne Environmental	AP-1000	10"	140.0	0.0	141.5

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
8.5/94		6	4470.60	4468.6	70.8/4397.8 12-01-90 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140-lbs / 30-in	4-in / 129-ft	Garrett Day

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							4468.6	0	0 - 5 ft. SLAG GRAVEL (FILL): Medium gray (5N5): dry.	Dual-wall percussion drilling with reverse air circulation.
SS	1.5	1.5	8 8 10				4463.6	5	5 - 28 ft. SILT (ML): Grayish brown (5 YR 3/2) to moderate brown (5 YR 4/4) to dark yellowish brown (10 YR 4/2), dry, stiff, nonplastic, calcareous clayey silt. Trace of slag gravel at 10 ft depth.	Air-water mist (<1 gpm) used where needed to restore circulation. Logged from drill cuttings and from split-spoon samples using the Unified Soil Classification System (ASTM D 2488-84) and the GSA Rock Color Chart.
SS	1.5	1.3	9 13 11					20		
							4440.6	28	28 - 45 ft. SILTY SAND WITH GRAVEL (SM): Dark yellowish brown (10 YR 4/2), dry, well-graded, subangular-to-subrounded sand, 30% silt and clay, 30% poorly-graded, subrounded gravel and cobbles (diameter ≤ 6 in.).	
							4423.6	45	45 - 71 ft. SILT (ML): Dark yellowish brown (10 YR 4/2), dry, very stiff, slightly-to-moderately plastic, with calcareous nodules and trace sand and gravel.	
SS	1.5	1.2	10 21 24					50		

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65

SS = SPLIT SPOON; ST = SHELBY TUBE D = DENNISON; P = PITCHER; O = OTHER

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	2 OF 2	114

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
SS	1.5	1.5	17 15 25				4397.6		71 - 75 ft. **GRAVEL WITH SAND (GP)**: Dusky brown (5 YR 2/2), wet, poorly-graded angular gravel (diameter ≤ 1 in.) and coarse-grained sand with 10% silt and clay, and trace fine and medium-grained sand.	Encountered ground water during drilling at approximately 70 ft below the ground surface.
							4393.6	75	75 - 90 ft. **SILTY GRAVEL WITH SAND (GM) TO SILTY SAND WITH GRAVEL (SM)**: Dark yellowish brown (10 YR 4/2), wet, poorly-graded subangular gravel and cobbles (diameter ≤ 4 in.), well-graded subangular-to-subrounded sand, 30% silt and clay.	80-85 ft: Minimal ground-water discharge.
							4378.6	90	90 - 100 ft. **SILT (MH)**: Dark yellowish brown (10 YR 4/2), wet, stiff, with clay, calcareous nodules, and 20% angular coarse-grained sand and gravel (diameter ≤ 0.5 in.).	
SS	1.5	1.5	5 10 11					95		
							4368.6	100	100 - 110 ft. **SILTY GRAVEL (GM) TO GRAVELLY SILT (ML)**: Dark yellowish brown (10 YR 4/2), wet, poorly-graded subrounded gravel (diameter ≤ 0.5 in.) and clayey silt with coarse-grained sand.	
							4358.6	110	110 - 130 ft. **SILTY GRAVEL WITH SAND (GM)**: Dark yellowish brown (10 YR 4/2) to dusky brown (5 YR 2/2), wet, poorly-graded subangular-to-subrounded gravel (diameter ≤ 3 in.), 30% subangular medium to coarse-grained sand, 20% silt and clay.	115-125 ft: Abundant ground-water discharge.
							4338.6	130	130 - 135 ft. **SANDY SILT WITH GRAVEL (ML)**: Dark yellowish brown (10 YR 4/2), wet, clayey silt with 30% coarse-grained sand and gravel.	130-140 ft: Minimal ground-water discharge.
							4333.6	135	135 - 140 ft. **SILT (ML)**: Dark yellowish brown (10 YR 4/2), moderately plastic, with clay.	
SS	1.5	1.5	8 10 13					140		
							4327.1		TOTAL DEPTH: 141.5 FT.	Boring converted to well on 10-17-90.

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE	Last Update:	HOLE NO.
Northeast of Pond 15S	11-10-93	114

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	1 OF 3	131

SITE	COORDINATES and/or STATIONINGS	ANGLE FROM HORIZ	BEARING
N of Ponds 8E and 11S-14S	N 450,212.0 E 553,742.7	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-23-90	10-23-90	Layne Environmental	AP-1000	10"	167.0	0.0	167.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
4.2/93		3	4485.95	4484.5	87.0/4397.6 12-01-90 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140-lbs / 30-in	4-in / 165.6-ft	Garrett Day

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							4484.5	0	0 - 2 ft. **SLAG GRAVEL (FILL)**: Medium gray (5N5).	Dual-wall percussion drilling with reverse air circulation.
							4482.5	2	2 - 45 ft. **SILT (ML)**: Moderate brown (5 YR 3/4) to dark yellowish brown (10 YR 4/2), slightly moist, stiff, slightly plastic, calcareous, with trace of coarse-grained sand and gravel.	Air-water mist (<1 gpm) used where needed to restore circulation. Logged from drill cuttings and from split-spoon samples using the Unified Soil Classification System (ASTM D 2488-84) and the GSA Rock Color Chart.
SS	1.5	1.5	10 10 10					5		
SS	1.5	1.2	16 12 14					40		
							4439.5	45	45 - 62 ft. **SILTY SAND WITH GRAVEL (SM)**: Dark yellowish brown (10 YR 4/2), dry, medium dense, subangular, medium to coarse-grained sand with 30% subangular-to-subrounded gravel (diameter 0.5-5 in.) of volcanic and metamorphic lithologies, 20% silt, trace fine-grained sand.	
							4422.5	62	62 - 100 ft. **SILT (ML)**: Moderate yellowish brown (10 YR 5/4), dry, medium stiff, clayey silt to very fine sand, slightly plastic, calcareous, trace medium-grained sand and gravel.	

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	2 OF 3	131

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
								85		Encountered ground water during drilling at approximately 85 ft below the ground surface.
SS	1.5	1.5	3 4 10					90		
							4384.5	100	100 - 120 ft. **SILTY SAND (SM)**: Moderate yellowish brown (10 YR 5/4), wet, 35-50% fine-grained sand, 35-50% clayey silt, 0-30% subrounded medium-grained sand to gravel (diameter ≤ 0.25 in.).	
							4364.5	120	120 - 125 ft. **GRAVELLY SILT (ML)**: Moderate yellowish brown (10 YR 5/4), wet, 50% clayey silt, 50% subrounded gravel (diameter ≤ 2 in.).	120-125 ft: Minimal ground-water discharge.
							4359.5	125	125 - 150 ft. **SILTY CLAY (CL)**: Dark yellowish brown (10 YR 4/2), moderately plastic silty clay with 20% fine to medium-grained sand.	
								130		130-135 ft: Minimal ground-water discharge.
								143	143-145 ft. 50% Silty clay, 50% subrounded gravel (diameter ≤ 2 in.).	
							4334.5	150		

Depth scale: 75, 80, 85, 90, 95, 100, 105, 110, 115, 120, 125, 130, 135, 140, 145

SS = SPLIT SPOON; ST = SHELBY TUBE D = DENNISON; P = PITCHER; O = OTHER

SITE	Last Update:	HOLE NO.
N of Ponds 8E and 11S-14S	11-10-93	131

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	3 OF 3	131

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
								150–165 (155, 160, 165)			150 - 165 ft. **CLAYEY GRAVEL (GC)**: Dark yellowish brown (10 YR 4/2), 50% coarse sand to angular gravel (diameter ≤ 3 in.) and 50% clay.	150-165 ft: Abundant ground-water discharge.
							4319.5	165			165 - 167 ft. **SANDY CLAY WITH GRAVEL (CL)**: Dark yellowish brown (10 YR 4/2), wet, 60% silty clay, 20% angular medium to coarse-grained sand, 20% gravel of volcanic lithologies.	Boring converted to well on 10-23-90.
							4317.5				TOTAL DEPTH: 167.0 FT.	

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE: N of Ponds 8E and 11S-14S

Last Update: 11-10-93

HOLE NO. 131

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	1 OF 2	132

SITE	COORDINATES and/or STATIONINGS	ANGLE FROM HORIZ	BEARING
N of Ponds 8E and 11S-14S	N 450,471.5 E 553,994.6	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
10-28-90	10-29-90	Layne Environmental	AP-1000	10"	125.5	0.0	125.5

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
4.7/78		4	4484.59	4482.7	85.1/4397.6 12-01-90 /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140-lbs / 30-in	4-in / 118.6-ft	Garrett Day

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH
							4482.7	0
SS	1.5	0.5	6 12 25					10
							4467.7	15
SS	1.5	1.2	10 13 90				4457.7	25
							4442.7	40
							4427.7	55
							4422.7	60

DESCRIPTION AND CLASSIFICATION

0 - 15 ft. **SILT (ML) AND SLAG GRAVEL (FILL)**: Dark yellowish brown (10 YR 4/2), calcareous silt and medium gray (5N5) slag gravel, dry.

15 - 25 ft. **GRAVELLY SILT WITH SAND (ML) TO SILTY GRAVEL WITH SAND (GM)**: Dark yellowish brown (10 YR 4/2), dry, 50-70% slightly plastic, calcareous silt, 30-50% medium-grained sand to angular-to-subangular gravel (diameter ≤ 0.5 in.) with calcareous coating.

25 - 40 ft. **SILT (ML)**: Moderate brown (5YR 4/4), dry, slightly plastic, calcareous clayey silt with trace subrounded medium to coarse-grained sand and calcareous nodules.

40 - 55 ft. **SILTY SAND (SM)**: Dark yellowish brown (10 YR 4/2), dry, well-graded subangular-to-subrounded sand, 30% calcareous silt, 10% subrounded gravel and cobbles.

55 - 60 ft. **SILTY GRAVEL WITH SAND (GM)**: Dark yellowish brown (10 YR 4/2), dry, 40% subrounded gravel (diameter ≤ 5 in.), 40% silt, 20% well-graded subangular-to-subrounded sand.

60 - 100 ft. **SILT (ML)**: Dark yellowish brown (10 YR 4/2), dry to moist, stiff, slightly plastic, calcareous clayey silt with trace sand, gravel, and calcareous nodules.

NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.

Dual-wall percussion drilling with reverse air circulation.

Air-water mist (<1 gpm) used where needed to restore circulation.

Logged from drill cuttings and from split-spoon samples using the Unified Soil Classification System (ASTM D 2488-84) and the GSA Rock Color Chart.

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE	Last Update:	HOLE NO.
N of Ponds 8E and 11S-14S	11-10-93	132

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	2 OF 2	132

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
								75		
								80		
SS	1.5	1.5	6 7 11					85		Encountered ground water during drilling at approximately 85 ft below the ground surface.
								90		
								95		
							4382.7	100	100 - 105 ft. **SILTY GRAVEL (GM)**: Dark yellowish brown (10 YR 4/2), wet, 50% subrounded gravel (diameter ≤ 3 in.), 40% silt, and 10% subangular medium to coarse-grained sand.	100 ft: Moderate ground-water discharge.
							4377.7	105	105 - 112 ft. **SANDY GRAVEL (GW)**: Grayish red (10 Y 4/2), wet, well-graded subangular-to-subrounded gravel (diameter ≤ 3 in.) of metamorphic and volcanic lithologies, 30% subangular well-graded sand, and 10% silt and clay.	105-112 ft: Abundant ground-water discharge.
								110		
							4370.7		112 - 120 ft. **SILTY GRAVEL WITH SAND (GM)**: Dark yellowish brown (10 YR 4/2), wet, subrounded gravel with 30% clayey silt and 20% subrounded well-graded sand. Interbedded clayey silt.	
								115		115-124 ft: Minimal ground-water discharge.
							4362.7	120	120 - 124 ft. **SILT (ML)**: Moderate brown (5 YR 3/4), wet, very stiff, slightly plastic, calcareous clayey silt with 20% black granular deposits occurring in fine and coarse-grained sand sizes.	
SS	1.5	1.5	9 17 26				4357.2	125		
									TOTAL DEPTH: 125.5 FT.	Boring converted to well on 10-28-90.

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE	Last Update:	HOLE NO.
N of Ponds 8E and 11S-14S	11-10-93	132

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	1 OF 2	167

SITE	COORDINATES and/or STATIONINGS	ANGLE FROM HORIZ	BEARING
FMC Corporation	N 449,404.1 E 554,015.5	Vertical	------

BEGUN	COMPLETED	DRILLER	DRILL MAKE AND MODEL	SIZE	OVERBURDEN	ROCK (FT.)	TOTAL DEPTH
8-22-95	8-24-95	Layne Environmental	AP-1000	10"	139.0	0.0	139.0

CORE RECOVERY (FT./%)	CORE BOXES	SAMPLES	EL. TOP CASING	GROUND EL.	DEPTH/EL. GROUND WATER	DEPTH/EL. TOP OF ROCK
/		15	4492.17	4490.1	92.3/4397.8 (9-5-95) /	/

SAMPLE HAMMER WEIGHT/FALL	CASING LEFT IN HOLE: DIA./LENGTH	LOGGED BY:
140 lbs. / 30 in.	4" PVC / 138.7 ft.	Curtis Obi

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	GRAPHICS	SAMPLE	DESCRIPTION AND CLASSIFICATION (Template: BCHTLLS)	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
							4490.1	0			0 - 65 ft. **SILT (ML)**: Light brown (5YR 5/6); 0-20% angular to subangular basaltic gravel to 1/4"; dry.	Boring drilled using Dual-wall percussion method with reverse air circulation.
								10			At 10 feet, becomes moist and soft.	Soil descriptions based on observations of drill cuttings and split-spoon samples using the Unifed Soil Classification System (ASTM D 2488) and the GSA Rock Color Chart.
							4425.1	65			65 - 77 ft. **SILTY SAND with GRAVEL (SM)**: Light brown (5YR 5/6); fine-grained sand; 30% silt; 30% angular to subrounded gravel to 4", medium gray to black, basaltic; moist.	

Depth scale: 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE	Last Update:	HOLE NO.
FMC Corporation	10-19-95	167

BECHTEL

GEOLOGIC DRILL LOG

PROJECT	JOB NO.	SHEET NO.	HOLE NO.
EMF POCATELLO, ID	21372	2 OF 2	167

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" / % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.
SS	1.5	1.5	13-21-23			
SS	2.0	1.3	25-31-24-25			
SS	2.0	1.9	24-38-33-34			
SS	2.0	1.6	12-17-19-24			
SS	2.0	1.4	12-16-16-14			
SS	2.0	2.0	10-15-13-14			
SS	2.0	2.0	8-14-13-23			
SS	2.0	2.0	24-38-41-42			
SS	2.0	1.7	5-9-12-13			
SS	2.0	2.0	17-17-15-15			
SS	2.0	2.0	5-11-22-17			
SS	2.0	2.0	8-18-23-24			
SS	2.0	2.0	9-14-34-42			
SS	2.0	2.0	9-16-20-26			
SS	2.0	2.0	4-9-18-22			

ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
	75		
4413.1		77 - 95 ft. **SILT (ML)**: Light brown (5YR 5/6); 40% very fine-grained sand; soft, loose, moist.	
	80		
	85	At 87 feet, becomes saturated.	At approx. 87 ft. encountered saturated soil.
	90		
4395.1	95	95 - 97 ft. **SILTY SAND (SM)**: Light brown (5YR 5/6); very fine-grained sand; 40% silt; saturated.	
4393.1		97 - 98 ft. **SAND (SP)**: Brownish black (5YR 2/1); medium-grained sand; 5-10% silt; medium dense, saturated.	
4392.1	100	98 - 139 ft. **SILT (ML)**: Moderate yellowish brown (10YR 5/4); 20-40% fine-grained sand; 0-10% coarse-grained sand and angular gravel to 1/2"; soft to firm, saturated.	
	105		
	110		
	115	At 115 - 116 feet, hard calcite-cemented silt layer.	Below 116 ft. water yield increases with depth.
	120	Below 116 feet, scattered thin layers of hard calcite-cemented silt. Percent sand and grain size increases with depth.	
	125		
	130		
	135		
4351.1		At 139 feet, some 1" diameter soft, blue-gray, clayballs.	Installed 4" monitoring well on 8/24/95.
		TOTAL DEPTH: 139.0 FEET	

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; O = OTHER

SITE	Last Update:	HOLE NO.
FMC Corporation	10-19-95	167

GEOLOGIC DRILL LOG

PROJECT	*EMF POCATELLO, ID*	JOB NO. 21372	SHEET NO. 1 OF 2	HOLE NO. 168		
SITE	FMC Corporation	COORDINATES and/or STATIONINGS	N 450,082.2 E 553,285.9	ANGLE FROM HORIZ: Vertical	BEARING: ------	
BEGUN: 8-28-95	COMPLETED: 8-28-95	DRILLER: Layne Environmental	DRILL MAKE AND MODEL: AP-1000	SIZE: 10"	OVERBURDEN: 93.5	ROCK (FT.):	TOTAL DEPTH: 93.5
CORE RECOVERY (FT./%): /	CORE BOXES:	SAMPLES: 14	EL. TOP CASING: 4473.94	GROUND EL.: 4471.6	DEPTH/EL. GROUND WATER: 75.6/4396.0 (9-6-95) /	DEPTH/EL. TOP OF ROCK: /
SAMPLE HAMMER WEIGHT/FALL: 140 lbs. / 30 in.	CASING LEFT IN HOLE: DIA./LENGTH: 4" PVC / 93.0 ft.	LOGGED BY: Curtis Obi				

(Template: BCHTLLS)

ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
4471.6	0	0 - 12 ft. SLAG GRAVEL (FILL): Gray; gravel to 6"+; 20-50% medium- to coarse-grained sand slag; loose, moist.	Boring drilled using Dual-wall percussion method with reverse air circulation.
4459.6	12	12 - 28 ft. SANDY SILT (ML): Pale yellowish brown (10YR 6/2); 20-40% fine-grained sand; soft, moist.	Soil descriptions based on observations of drill cuttings and split-spoon samples using the Unifed Soil Classification System (ASTM D 2488) and the GSA Rock Color Chart.
4443.6	28	28 - 48 ft. SILTY GRAVEL (GM): Dusky yellowish brown (10YR 2/2) to Moderate yellowish brown (10YR 5/4); subangular to subrounded gravel to 6", colorful quartzite and metamophics; 20-40% fine- to coarse-grained sand; 20% silt; loose, dry to moist.	
4423.6	48	48 - 92 ft. SILT (ML): Dark yellowish orange (10YR 6/6); 20% fine-grained sand; 0-20% subrounded gravel to 5", larger cobbles of quartzite and metamorphics, 1/4" gravels of mostly basalt; soft, moist.	

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS/6" % CORE RECOVERY	LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.
SS	2.0	2.0	12-17-19-21			
SS	2.0	1.7	10-11-14-16			
SS	2.0	2.0	10-14-			

SS = SPLIT SPOON; ST = SHELBY TUBE D = DENNISON; P = PITCHER; O = OTHER

GEOLOGIC DRILL LOG

PROJECT: *EMF POCATELLO, ID* | JOB NO. 21372 | SHEET NO. 2 OF 2 | HOLE NO. 168

(Template: BCHTLLS)

SAMP. TYPE AND DIAM.	SAMP. ADV. LEN CORE	SAMPLE REC. CORE REC.	SAMPLE BLOWS "N" % CORE RECOVERY	WATER PRESSURE TESTS: LOSS IN G.P.M	PRESS. P.S.I.	TIME IN MIN.	ELEV.	DEPTH	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
			15-21							
SS	2.0	1.6	6-10-12-15						At 72 feet, saturated.	
SS	2.0	2.0	3-6-7-11					75		
SS	2.0	2.0	3-5-6-9							
SS	2.0	2.0	2-3-9-15							
SS	2.0	2.0	7-11-15-17					80		
SS	2.0	1.8	7-12-17-21							
SS	2.0	2.0	8-15-11-18					85		
SS	2.0	2.0	10-12-19-23							
SS	2.0	2.0	6-8-11-17							At 87 ft. moderate yield of muddy water.
SS	2.0	2.0	6-11-17-20					90		
SS	2.0	2.0	6-14-12-15				4379.6			
							4378.1		92 - 93.5 ft. **CLAYEY SILT (ML)**: Moderate brown (5YR 4/4); 10% fine-grained sand; stiff, low plasticity, saturated.	Installed 4" monitoring well on 8/30/95.

TOTAL DEPTH: 93.5 FEET

SS = SPLIT SPOON; ST = SHELBY TUBE
D = DENNISON; P = PITCHER; 0
= OTHER

SITE: FMC Corporation | Last Update: 10-19-95 | HOLE NO. 168

APPENDIX B

MONITORING WELL COMPLETION DIAGRAMS

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	104

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	NE of Ponds 8E and 11S-14S	N 450,146 E 554,270

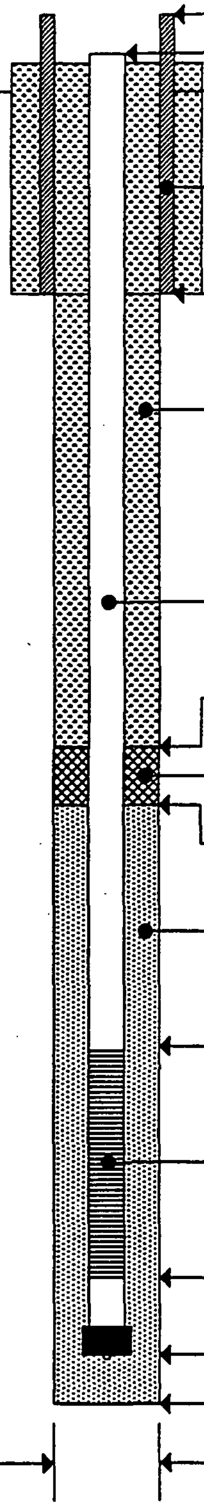
BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
11-7-90	11-7-90	Curtis Obi	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

Plugged on: 11-6-90

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.4	4487.0
TOP OF RISER CASING	2.1	4486.7
GROUND SURFACE	0.0	4484.6
BOTTOM OF SURFACE CASING	2.6	4482.0
TOP OF SEAL	84.0	4400.6
TOP OF FILTER PACK	88.0	4396.6
TOP OF SCREEN	96.5	4388.1
BOTTOM OF SCREEN	106.5	4378.1
BOTTOM OF SUMP	109.0	4375.6
BOTTOM OF HOLE	110.0	4374.6

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 8-12-92
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL	PROJECT: *EMF POCATELLO, ID*	WELL NO.: 114

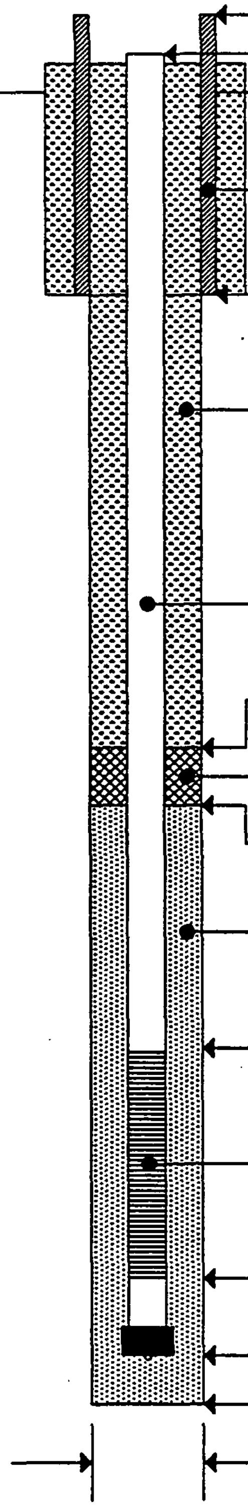
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	Northeast of Pond 15S	N 449,849 E 553,030

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-16-90	10-17-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.2	4470.8
TOP OF RISER CASING	2.0	4470.6
GROUND SURFACE	0.0	4468.6
BOTTOM OF SURFACE CASING	2.8	4465.8
TOP OF SEAL	108.0	4360.6
TOP OF FILTER PACK	112.0	4356.6
TOP OF SCREEN	116.7	4351.9
BOTTOM OF SCREEN	126.2	4342.4
BOTTOM OF SUMP	129.0	4339.6
BOTTOM OF HOLE	141.5	4327.1

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 11-10-93
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	131

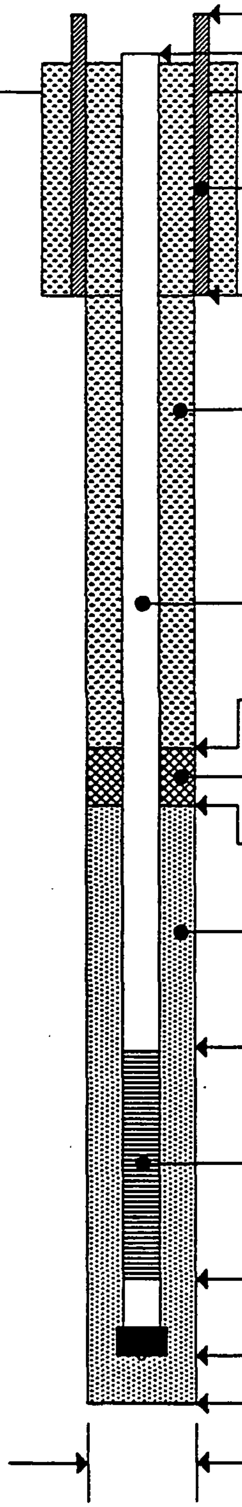
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	N of Ponds 8E and 11S-14S	N 450,212 E 553,743

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-23-90	10-23-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	1.7	4486.2
TOP OF RISER CASING	1.4	4485.9
GROUND SURFACE	0.0	4484.5
BOTTOM OF SURFACE CASING	3.3	4481.2
TOP OF SEAL	143.0	4341.5
TOP OF FILTER PACK	147.0	4337.5
TOP OF SCREEN	153.9	4330.6
BOTTOM OF SCREEN	163.9	4320.6
BOTTOM OF SUMP	165.6	4318.9
BOTTOM OF HOLE	167.0	4317.5

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 80 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 80 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 11-10-93
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL

PROJECT	WELL NO.
EMF POCATELLO, ID	132

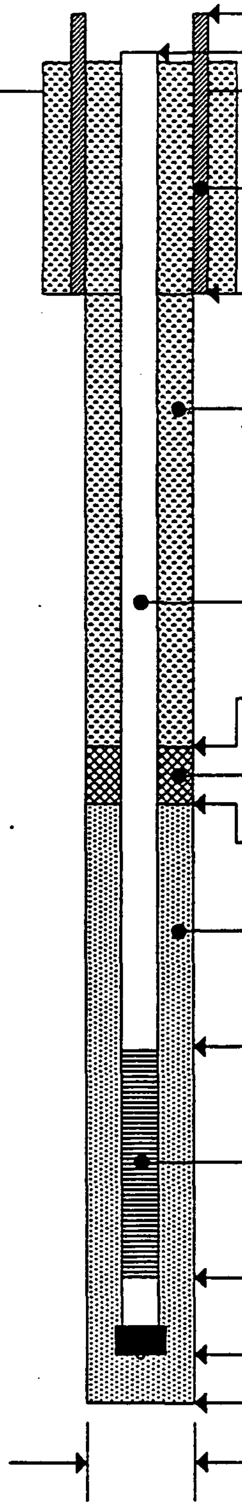
JOB NO.	SITE	COORDINATES and/or STATIONING
21372	N of Ponds 8E and 11S-14S	N 450,472 E 553,995

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
10-28-90	10-28-90	Garrett Day	Top of PVC casing(Water level)

(GENERALIZED GEOLOGIC LOG)

See Boring Logs.

NOT TO SCALE



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.2	4484.9
TOP OF RISER CASING	1.9	4484.6
GROUND SURFACE	0.0	4482.7
BOTTOM OF SURFACE CASING	2.8	4479.9
TOP OF SEAL	97.5	4385.2
TOP OF FILTER PACK	101.5	4381.2
TOP OF SCREEN	106.4	4376.3
BOTTOM OF SCREEN	115.9	4366.8
BOTTOM OF SUMP	118.6	4364.1
BOTTOM OF HOLE	125.5	4357.2

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with locking lid

BACKFILL MATERIAL TYPE
Cement - Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
Silica sand 10-20 & 20-40

SCREEN
DIAMETER: 4"
TYPE: Sch. 40 PVC/Machine Cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 11-10-93
Template: 2WELLOG

NOT TO SCALE

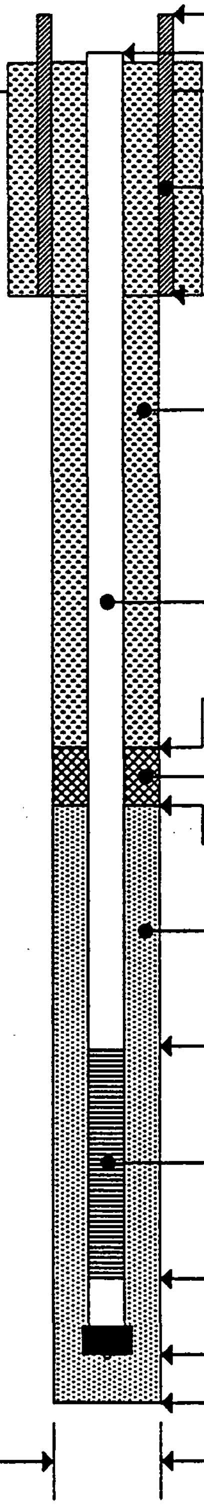
MONITORING WELL	PROJECT: *EMF POCATELLO, ID*	WELL NO.: 167

JOB NO.	SITE	COORDINATES and/or STATIONING
21372	FMC Corporation	N 449,404 E 554,016

BEGUN	COMPLETED	PREPARED BY	REFERENCE POINT FOR MEASUREMENTS
8-23-95	8-24-95	Curtis Obi	Top of PVC Casing-Water Levels

(GENERALIZED GEOLOGIC LOG)

See Geologic Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.5	4492.6
TOP OF RISER CASING	2.1	4492.2
GROUND SURFACE	0.0	4490.1
BOTTOM OF SURFACE CASING	2.5	4487.6
TOP OF SEAL	103.5	4386.6
TOP OF FILTER PACK	113.5	4376.6
TOP OF SCREEN	116.5	4373.6
BOTTOM OF SCREEN	136.5	4353.6
BOTTOM OF SUMP	139.0	4351.1
BOTTOM OF HOLE	139.0	4351.1

SURFACE CASING
DIAMETER/TYPE: 8"/ Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE: 4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

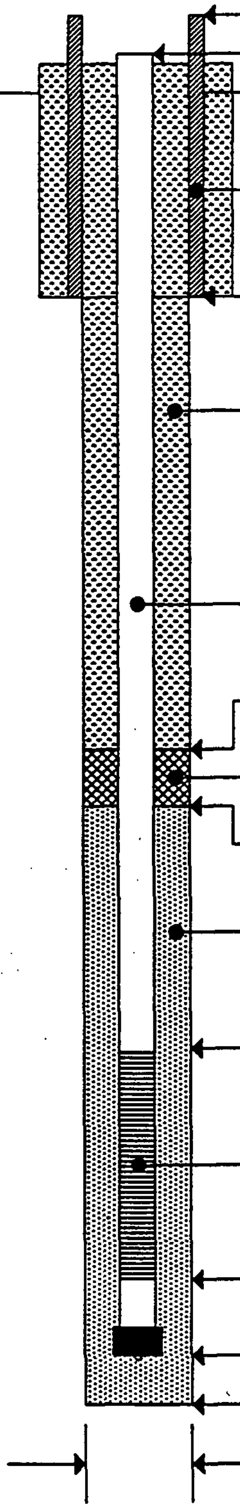
Update: 10-19-95
Template: 2WELLOG

NOT TO SCALE

MONITORING WELL	PROJECT: EMF POCATELLO, ID			WELL NO.: 168
JOB NO.: 21372	SITE: FMC Corporation		COORDINATES and/or STATIONING: N 450,082 E 553,286	
BEGUN: 8-30-95	COMPLETED: 8-30-95	PREPARED BY: Curtis Obi	REFERENCE POINT FOR MEASUREMENTS: Top of PVC Casing-Water Levels	

(GENERALIZED GEOLOGIC LOG)

See Geologic
Drill Log for Details.



	DEPTH (FT)	ELEV. (FTMSL)
TOP OF SURFACE CASING	2.7	4474.3
TOP OF RISER CASING	2.3	4473.9
GROUND SURFACE	0.0	4471.6
BOTTOM OF SURFACE CASING	2.3	4469.3
TOP OF SEAL	61.0	4410.6
TOP OF FILTER PACK	71.0	4400.6
TOP OF SCREEN	75.5	4396.1
BOTTOM OF SCREEN	90.5	4381.1
BOTTOM OF SUMP	93.0	4378.6
BOTTOM OF HOLE	93.5	4378.1

SURFACE CASING
DIAMETER/TYPE:
8"/
Steel with Locking Lid

BACKFILL MATERIAL TYPE
Cement-Bentonite Grout

RISER CASING
DIAMETER/TYPE:
4"/Schedule 40 PVC

ANNULAR SEAL TYPE
Bentonite Slurry

FILTER PACK TYPE
CSSI 16-30 Silica Sand

SCREEN
DIAMETER: 4"
TYPE: Schedule 40 PVC machine-cut
OPENING WIDTH: 0.020"

HOLE DIAMETER: 10"

Update: 10-19-95
Template: 2WELLOG

NOT TO SCALE

Appendix C

APPENDIX C

EPA GUIDANCE REGARDING RCRA/CERCLA COORDINATION

United States
Environmental Protection
Agency

Region 10
1200 Sixth Avenue
Seattle WA 98101

Alaska
Idaho
Oregon
Washington

EPA

April 19, 1991

MEMORANDUM

SUBJECT: RCRA/CERCLA MOU for Eastern Michaud Flats

FROM: Bill Adams
Project Manager

TO: Philip G. Millam, Chief
Superfund Branch

Mike Gearheard, Chief
Waste Management Branch

THRU: Catherine Krueger, Chief
Site Management Section III

Carrie Sikorski, Chief
RCRA Permit Section

Attached for your concurrence/signature is an agreement developed for the Eastern Michaud Flats Superfund site to better coordinate the Resource Conservation and Recovery Act/Comprehensive Environmental Response, Compensation, and Liability Act (RCRA/CERCLA) issues. Following is a brief background on the site.

The Eastern Michaud Flats Superfund site consists of two operating facilities, FMC and Simplot. As a result of a change in the mining waste exclusions, FMC became subject to RCRA last year (Currently Simplot's wastes are not subject to regulation under RCRA). As a result in this change in regulation, FMC recently submitted its part B application for the newly regulated wastes and units. They have also installed a number of wells to meet the RCRA groundwater monitoring requirements.

In January, FMC and Simplot were issued a Consent Order for conducting a Remedial Investigation/Feasibility Study (RI/FS) for the site. Negotiations on this order and the RI/FS Scope of Work will begin in the next few weeks.

Last fall, representatives of FMC met with EPA to request that there be some sort of coordination between the RCRA and CERCLA programs. It was agreed by EPA that the situation was unique and a special effort was required in order to avoid duplication between the RCRA and CERCLA programs. In order to facilitate communication, we have drafted the attached Memorandum of Understanding (MOU) between the two EPA programs. We have also set up a Steering Committee to discuss and coordinate the various program activities for this site. This committee has representatives of EPA (RCRA & CERCLA), the State of Idaho, the Shoshone-Bannock Tribe, and FMC.

It is important to note it is fairly unique to have an operating RCRA facility also on the NPL and subject to CERCLA. It is because of this situation that the attached MOU was developed. In general, such an agreement would not be necessary for other non-RCRA Superfund sites.

Please call me at (206) 553-2806 if you have any questions or concerns regarding the MOU, or the site in general.

cc: Dave Croxton, WMB
Cyndy Mackey, ORC
Philip Millam, Superfund

Region 10 Memorandum of Understanding
Between the RCRA Program and the CERCLA Program
Regarding Coordination of Remedial Activities at
the Eastern Michaud Site

This memorandum is written to outline the process by which the Region 10 RCRA Program and the CERCLA Program will coordinate their regulatory activities at the Eastern Michaud Site during the RI/FS study activities at FMC.[1]

It is agreed that the RFI and RI/FS study activities will be completed under one agreement, to the extent possible, which is entered into under CERCLA. CERCLA will have the lead for conducting the RI/FS, or overseeing the PRPs, and coordinating the involvement of the RCRA and CERCLA programs during the RI/FS. It is believed that the broad remedial authorities of CERCLA can meet the remedial requirements under RCRA. This is consistent with the guidance provided in the RCRA Orientation Manual dated 1990 and the RCRA proposed corrective action rules dated July 27, 1990 (55 Fed. Reg. 30798).[2]

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1 The policy and procedures set forth herein are intended solely for the guidance of the U.S. Environmental Protection Agency. They may not be relied upon to create a right or benefit, substantive or procedural, enforceable at law or in equity by any person. The Agency may take any action which is at variance with the policies or procedures contained in this memorandum.

2 "EPA anticipates that the two programs will arrive at similar solutions to similar environmental problems, and that actions undertaken by one program will be adopted by the other program in cases where the programmatic responsibility for a site shifts from one to the other. Specifically, the Agency anticipates that there may be a number of facilities at which substantial CERCLA remedial studies and/or actual remediation will have been already conducted at the time a RCRA permit is issued (thereby triggering the Subpart S corrective action requirements). This situation is likely to be most common at Federal facilities. In such cases, if the remedial work has been conducted according to the CERCLA NCP, EPA would consider that work to be consistent with the requirements of subpart S, and therefore additional or different studies or cleanup requirements would be unnecessary. If, however, the remedial activities conducted pursuant to the NCP at a RCRA facility addressed only a portion of the units or releases at the facility requiring remediation, the permit would address any such remaining corrective action requirements pursuant to subpart S." 55 Fed. Reg. 30852 (July 27, 1990).

The RCRA requirements which must be considered during the CERCLA RI/FS include the RCRA Facility Assessment (RFA) and the RCRA Facility Investigation ("RFI"). The RFA is an Agency-conducted assessment, which is analogous to the Superfund Preliminary Assessment/Site Investigation ("PA/SI"). However, the RFA identifies each solid waste management unit at the facility and evaluates the potential for release of hazardous constituents on a unit-specific basis. The RFI is comparable to the Remedial Investigation in the Superfund program. See 55 Fed. Reg. 30810 (July 27, 1990). See also RFI Guidance. In addition, a number of the RCRA requirements associated with FMC's Part B application may be incorporated into the CERCLA process. Both programs will coordinate these requirements as follows.

A. RFA

In accordance with the RCRA Facility Assessment Guidance, the RCRA program will utilize the findings of the Superfund PA/SI to help develop the RFA. Any additional information collected during the RFA will be coordinated with the CERCLA process. A site visit may be necessary in order to complete the RFA. The CERCLA program will review and comment on relevant RFA documents. These comments will be incorporated into the final RFA where appropriate.

B. RFI

In accordance with the RCRA Corrective Action Rules and the RFI Guidance, the RCRA Program recognizes that the requirements for the RFI can be satisfied by a CERCLA Remedial Investigation ("RI"). The RCRA Program will review and comment on relevant RI documents. The RI will incorporate these comments where applicable or relevant and appropriate. Any issues that can not be resolved at the staff level will be raised through the normal Hazardous Waste Division chain-of-command. If it is agreed that certain RFI needs will not be addressed by the RI, then the RCRA permit will incorporate the necessary RFI requirements. However the goal is to fully incorporate the RFI into the RI.

C. RCRA Compliance

The RCRA Permit Project Manager will keep the CERCLA Project Manager informed about RCRA activities at FMC, including notifying the CERCLA Project Manager prior to initiation of any proposed remedial activities under RCRA. The Project Managers will meet to determine how these remedial activities can be integrated into the CERCLA activities. The RCRA compliance program will continue to perform site inspections and undertake necessary enforcement activities. Significant findings from these inspections will be made available to the CERCLA Project

Manager.

The information gathered for FMC's Part B application should be incorporated into the CERCLA process including information relating to the following:

-Characterization of site hydrogeology and certification of compliance with groundwater monitoring requirements.
-Compliance with financial responsibility requirements.
-Information regarding on-site waste management.
-Management/Operation including:

-Groundwater
-Closure/Post Closure
-Financial Assurance
-Engineering plans to upgrade the facility
-Minimum Technology Requirements (MTR)

The CERCLA Project Manager will be responsible for identifying Applicable or Relevant and Appropriate Requirements (ARARs) relating to the RCRA program and for keeping the RCRA Project Manager as well as other members of the Steering Committee informed of such determinations in a timely manner.

D. Corrective Action

Most remedial activities will likely occur after a ROD is signed. If early corrective action under RCRA is necessary during the RI/FS activities, it could be performed as an Interim Remedial Action or Removal, unless it is beyond the scope of the CERCLA process. If necessary it could be imposed as a RCRA interim stabilization measure upon concurrence of the RCRA and CERCLA programs.

This MOU recognizes that the Feasibility Study and the ROD may consider the possibility of undertaking some of the agreed upon remedial activities at FMC as part of the RCRA corrective action program. The FS and the ROD will require the review and concurrence of both the RCRA Program and the CERCLA Program.

E. Steering Committee

A Steering Committee will be formed to facilitate coordination of the various legal requirements (including RCRA requirements) with the CERCLA activities at FMC. It is anticipated that the committee will contain a representative of the EPA RCRA program, a representative of the Shoshone-Bannock Tribe, a representative of the State of Idaho, a representative of EPA's Idaho Operations Office, a representative of the RCRA Facility (FMC at this time), and a representative of the EPA CERCLA program. The members of this Steering Committee would present any site characterization or remediation needs deemed necessary by their individual programs to the Steering Committee for discussion as to how these needs can best be addressed during the RI/FS activities. As the RI/FS activities begin to explore alternatives, the Steering Committee would be instrumental in ensuring that the alternatives considered meet the needs of the various regulatory programs.

F. Negotiations with PRPs

The CERCLA program will have the lead in the negotiations with the PRPs for conducting the RI/FS. The RCRA staff will be involved as a member of the Steering Committee in verifying information supplied by the PRPs and any discussions regarding particular RCRA units and their incorporation into the RI/FS.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

SEP 24 1996

MEMORANDUM

SUBJECT: Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities

FROM: Steven A. Herman
Assistant Administrator
Office of Enforcement and Compliance Assurance

Elliott P. Laws
Assistant Administrator
Office of Solid Waste and Emergency Response

TO: RCRA/CERCLA National Policy Managers
Regions I-X

Good RCRA/CERCLA coordination has become increasingly important as our offices have reorganized and programs have assumed new organizational relationships. We believe that, in general, coordination of site cleanup activities among EPA RCRA, EPA CERCLA and state/tribal cleanup programs has improved greatly; however, we are aware of examples of some remaining coordination difficulties. In this memo, we discuss three areas: acceptance of decisions made by other remedial programs; deferral of activities and coordination among EPA RCRA, EPA CERCLA and state/tribal cleanup programs; and coordination of the specific standards and administrative requirements for closure of RCRA regulated units with other cleanup activities. We also announce a revision to the Agency's policy on the use of fate and transport calculations to meet the "clean closure" performance standard under RCRA. We hope the guidance offered here will assist in your continuing efforts to eliminate duplication of effort, streamline cleanup processes, and build effective relationships with the states and tribes.

This memorandum focuses on coordination between CERCLA and RCRA cleanup programs; however, we believe the approaches outlined here are also applicable to coordination between either of these programs and certain state or tribal cleanup programs that meet appropriate criteria. For example, over half of the states have "Superfund-like" authorities. In some cases, these state authorities are substantially equivalent in scope and effect to the federal CERCLA program and to the state or federal RCRA corrective action program. In accordance with the 1984 Indian Policy, EPA recognizes tribes as sovereign nations, and will work with them on a government-to-government basis when coordinating cleanup efforts on lands under tribal jurisdiction.

In addition to the guidance provided in this memorandum, two other on-going initiatives address coordination of RCRA and CERCLA. First, EPA is currently coordinating an inter-agency and state "Lead Regulator Workgroup." This workgroup intends to provide guidance where overlapping cleanup authorities apply at federal facilities that identifies options for coordinating oversight and deferring cleanup from one program to another. We intend for today's memorandum and the pending guidance from the Lead Regulator Workgroup to work in concert to improve RCRA/CERCLA integration and coordination. Second, EPA has also requested comment on RCRA/CERCLA integration issues in the May 1, 1996 Advanced Notice of Proposed Rulemaking—Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities (61 FR 19432; commonly referred to as the RCRA "Subpart S" ANPR). We intend to coordinate all of these efforts as we develop further policy on integration issues.

Acceptance of Decisions Made by Other Remedial Programs

Generally, cleanups under RCRA corrective action or CERCLA will substantively satisfy the requirements of both programs.[1] We believe that, in most situations, EPA RCRA and CERCLA site managers can defer cleanup activities for all or part of a site from one program to another with the expectation that no further cleanup will be required under the deferring program. For example, when investigations or studies have been completed under one program, there should be no need to review or repeat those investigations or studies under another program. Similarly, a remedy that is acceptable under one program should be presumed to meet the standards of the other.

It has been our experience that, given the level of site-specific decision-making required for cleaning up sites, differences among the implementation approaches of the various remedial programs primarily reflect differences in professional judgement rather than structural inconsistencies in the programs themselves. Where there are differences in approaches among remedial programs, but not in their fundamental purposes or objectives (e.g., differences in analytical QA/QC procedures), these differences should not necessarily

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[1] In a few, limited cases, program differences may be sufficiently great to prevent deferral to the other program (e.g., the inability of CERCLA to address petroleum releases or RCRA to address certain radioactive materials). In these instances we encourage remedial programs to coordinate closely with each other to minimize duplication of effort, including oversight.

prevent deferral. We encourage program implementors to focus on whether the end results of the remedial activities are substantively similar when making deferral decisions and to make every effort to resolve differences in professional judgement to avoid imposing two regulatory programs.

We are committed to the principle of parity between the RCRA corrective action and CERCLA programs and to the idea that the programs should yield similar remedies in similar circumstances. To further this goal, we have developed and continue to develop a number of joint (RCRA/CERCLA) guidance documents. For example, the several "Presumptive Remedies," which are preferred technologies for common categories of sites, and the Guidance for Evaluating the Technical Impracticability of Ground-Water Restoration (OSWER Directive 9234.2-25, September 1993), which recognizes the impracticability of achieving groundwater restoration at certain sites, are applicable to both RCRA and CERCLA cleanups. For more information on the concept of parity between the RCRA and CERCLA programs see: 54 FR 41000, esp. 41006-41009 (October 4, 1989), RCRA deferral policy; 54 FR 10520 (March 13, 1989), National Priorities List for Uncontrolled Hazardous Waste Sites Listing Policy for Federal Facilities; 55 FR, 30798, esp. 30852-30853 (July 27, 1990), Proposed Rule for Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities; 60 FR 14641 (March 20, 1995), Deletion Policy for RCRA Facilities; and, 61 FR 19432 (May 1, 1996), Corrective Action for Releases From Solid Waste Management Units at Hazardous Waste Management Facilities, Advanced Notice of Proposed Rulemaking.

Program Deferral

The concept of deferral from one program to another is already in general use at EPA. For example, it has long been EPA's policy to defer facilities that may be eligible for inclusion on the National Priorities List (NPL) to the RCRA program if they are subject to RCRA corrective action (unless they fall within certain exceptions, such as federal facilities). Recently, EPA expanded on this policy by issuing criteria for deleting sites that are on the NPL and deferring their cleanup to RCRA corrective action (attached).[2] When a site is deleted from the NPL and deferred to RCRA, problems of jurisdictional overlap and duplication of effort are eliminated, because the site will be handled solely under RCRA authority. Corrective action permits or orders should address all releases at a CERCLA site being deferred to RCRA; some RCRA permits or orders may need to be modified to address all releases before a site is deleted from the NPL.

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2 Currently, the RCRA deletion policy does not pertain to federal facilities, even if such facilities are also subject to Subtitle C of RCRA. Site Managers are encouraged to use interagency agreements to eliminate duplication of effort at federal facilities; the Lead Regulator Workgroup intends to provide additional guidance on coordinating oversight and deferring cleanup from one program to another at federal facilities.

While EPA's general policy is for facilities subject to both CERCLA and RCRA to be cleaned up under RCRA, in some cases, it may be more appropriate for the federal CERCLA program or a state/tribal "Superfund-like" cleanup program to take the lead. In these cases, the RCRA permit/order should defer corrective action at all of the facility to CERCLA or a state/tribal cleanup program. For example, where program priorities differ, and a cleanup under CERCLA has already been completed or is underway at a RCRA facility, corrective action conditions in the RCRA permit/order could state that the existence of a CERCLA action makes separate RCRA action unnecessary. In this case, there would be no need for the RCRA program to revisit the remedy at some later point in time. Where the CERCLA program has already selected a remedy, the RCRA permit could cite the CERCLA decision document (e.g., ROD), but would not necessarily have to incorporate that document by reference. RCRA permits/orders can also defer corrective action in a similar way for cleanups undertaken under state/tribal programs provided the state/tribal action protects human health and the environment to a degree at least equivalent to that required under the RCRA program.

Superfund policy on deferral of CERCLA sites for listing on the NPL while states and tribes oversee response actions is detailed in the May 3, 1995 OSWER Directive 9375.6-11 ("Guidance on Deferral of NPL Listing Determinations While States Oversee Response Actions"). The intent of this policy is to accelerate the rate of response actions by encouraging a greater state or tribal role, while maintaining protective cleanups and ensuring full public participation in the decision-making process. Once a deferral response is complete, EPA will remove the site from CERCLIS and will not consider the site for the NPL unless the Agency receives new information of a release or potential release that poses a significant threat to human health or the environment. The state and tribal deferral policy is available for sites not listed on the NPL; deferral of final NPL sites must be addressed under the Agency's deletion policy, as described above.

Coordination Between Programs

While deferral from one program to another is typically the most efficient and desirable way to address overlapping cleanup requirements, in some cases, full deferral will not be appropriate and coordination between programs will be required. The goal of any approach to coordination of remedial requirements should be to avoid duplication of effort (including oversight) and second-guessing of remedial decisions. We encourage you to be creative and focus on the most efficient path to the desired environmental result as you craft strategies for coordination of cleanup requirements under RCRA and CERCLA and between federal and state/tribal cleanup programs.

Several approaches for coordination between programs at facilities subject to both RCRA and CERCLA are currently in use. It is important to note that options for coordination at federal facilities subject to CERCLA §120 may differ from those at non-federal facilities because of certain prescriptive requirements under §120. EPA anticipates issuing further guidance on coordination options specific to federal facilities through the interagency Lead Regulator Workgroup. Current approaches that are in use include:

Craft CERCLA or RCRA decision documents so that cleanup responsibilities are divided. CERCLA and RCRA decision documents do not have to require that the entire facility be cleaned up under one or the other program. For example, at some facilities being cleaned up under CERCLA, the RCRA units (regulated or solid waste) are physically distinct and could be addressed under RCRA. In these cases, the CERCLA decision documents can focus CERCLA activities on certain units or areas, and designate others for action under RCRA. When units or areas are deferred from CERCLA to RCRA, the CERCLA program should include a statement (e.g., in a ROD or memorandum submitted to the administrative record) that successful completion of these activities would eliminate the need for further cleanup under CERCLA at those units and minimal review would be necessary to delete the site from the NPL. Similarly, when units or areas are deferred from RCRA to CERCLA, RCRA permits or orders can reference the CERCLA cleanup process and state that complying with the terms of the CERCLA requirements would satisfy the requirements of RCRA.

Establish timing sequences in RCRA and CERCLA decision documents. RCRA and CERCLA decision documents can establish schedules according to which the requirements for cleanup at all or part of a facility under one authority would be determined only after completion of an action under the other authority. For example, RCRA permits/orders can establish schedules of compliance which allow decisions as to whether corrective action is required to be made after completion of a CERCLA cleanup or a cleanup under a state/tribal authority. After the state or CERCLA response is carried out, there should be no need for further cleanup under RCRA and the RCRA permit/order could simply make that finding. Similarly, CERCLA or state/tribal cleanup program decision documents could delay review of units or areas that are being addressed under RCRA, with the expectation that no additional cleanup will need to be undertaken pending successful completion of the RCRA activities, although CERCLA would have to go through the administrative step of deleting the site from the NPL.

A disadvantage of this approach is that it contemplates subsequent review of cleanup by the deferring program and creates uncertainty by raising the possibility that a second round of cleanup may be necessary. Therefore, we recommend that program implementers look first to approaches that divide responsibilities, as described above. A timing approach, however, may be most appropriate in certain circumstances, for example, where two different regulatory agencies are involved. Whenever a timing approach is used, the final review by the deferring program will generally be very streamlined. In conducting this review, there should be a strong presumption that the cleanup under the other program is adequate and that reconsidering the remedy should rarely be necessary.

The examples included in this memo demonstrate several possible approaches to deferring action from one cleanup program to another. For example, under RCRA, situations are described where the RCRA corrective action program would make a finding that no action is required under RCRA because the hazard is already being addressed under the CERCLA program, which EPA believes affords equivalent protection. In other examples, the RCRA program defers not to the CERCLA program per se, but either defers to a particular CERCLA ROD or actually incorporates such ROD by reference into a RCRA permit or order. In addition, there are examples where the Agency commits to revisit a deferral decision once the activity to which RCRA action is being deferred is completed; in other situations, reevaluation is not contemplated. As discussed in this memorandum, no single approach is recommended, because the decision of whether to defer action under one program to another and how to structure such a deferral is highly dependant on site-specific and community circumstances. In addition, the type of deferral chosen may raise issues concerning, for example, the type of supporting documentation that should be included in the administrative record for the decision, as well as issues concerning availability and scope of administrative and judicial review.

Agreements on coordination of cleanup programs should be fashioned to prevent revisiting of decisions and should be clearly incorporated and cross-referenced into existing or new agreements, permits or orders. We recognize that this up-front coordination requires significant resources. Our expectation is that, over the long-term, duplicative Agency oversight will be reduced and cleanup efficiency will be enhanced.

RCRA Closure and Post-Closure

Some of the most significant RCRA/CERCLA integration issues are associated with coordination of requirements for closure of RCRA regulated units[3] with other cleanup activities. Currently, there are regulatory distinctions between requirements for closure of RCRA regulated units and other cleanup requirements (e.g., RCRA corrective action requirements). RCRA regulated units are subject to specific standards for operation, characterization of releases, ground water corrective action and closure. Coordination of these standards with other remedial activities can be challenging. In the November 8, 1994 proposed Post-Closure Rule (59 FR 55778), EPA requested comment on an approach that

[3] In this document, the term "regulated unit" refers to any surface impoundment, waste pile, land treatment unit or landfill that receives (or has received) hazardous waste after July 26, 1982 or that certified closure after January 26, 1983.

would reduce or eliminate the regulatory distinction between cleanup of releases from closed or closing regulated units and cleanup of non-regulated unit releases under RCRA corrective action. The Office of Solid Waste will address this issue further in the final Post-Closure and Subpart S rules.

At the present time, however, the dual regulatory structure for RCRA closure and other cleanup activities remains in place. There are several approaches program implementors can use to reduce inconsistency and duplication of effort when implementing RCRA closure requirements during CERCLA cleanups or RCRA corrective actions. These approaches are analogous to the options discussed above for coordination between cleanup programs. For example, a clean-up plan for a CERCLA operable unit that physically encompasses a RCRA regulated unit could be structured to provide for concurrent compliance with CERCLA and the RCRA closure and post-closure requirements. In this example, the RCRA permit/order could cite the ongoing CERCLA cleanup, and incorporate the CERCLA requirements by reference. RCRA public participation requirements would have to be met for the permit/order to be issued; however, at many sites it may be possible to use a single process to meet this need under RCRA and CERCLA.

At some sites, inconsistent cleanup levels have been applied for removal and decontamination ("clean closure") of regulated units and for site-wide remediation under CERCLA or RCRA corrective action. Where this has happened, clean closure levels have been generally set at background levels while, at the same site, cleanup levels have been at higher, risk-based concentrations. To avoid this inconsistency and to better coordinate between different regulatory programs, we encourage you to use risk-based levels when developing clean-closure standards. The Agency has previously presented its position on the use of background and risk-based levels as clean closure standards (52 FR 8704-8709, March 19, 1987; attached). This notice states that clean closure levels are to be based on health-based levels approved by the Agency. If no Agency-approved level exists, then background concentrations may be used or a site owner may submit sufficient data on toxicity to allow EPA to determine what the health-based level should be.

EPA continues to believe, as stated in the March 19,1987 notice, that risk-based approaches are protective and appropriate for clean-closure determinations. In EPA's view, a regulatory agency could reasonably conclude that a regulated unit was clean-closed under RCRA if it was cleaned up under Superfund, RCRA corrective action, or certain state/tribal cleanup programs to the performance standard for clean closure. This performance standard can be met with the use of risk-based levels. RCRA units that did not achieve the closure performance standard under a cleanup would remain subject to RCRA capping and post-closure care requirements.

The 1987 federal register notice described EPA's policy that the use of fate and transport models to establish risk levels would be inappropriate for clean closure determinations. This discussion, however, also included the statement that, after additional experience with clean closures, "the Agency may decide that a less stringent approach is sufficiently reliable to assure that closures based on such analyses are fully protective of human health and the environment." After nine years of further experience, EPA believes that, consistent with the use of risk-based standards in its remedial programs, use of fate and transport models to establish risk levels can be appropriate to establish clean closure determinations. EPA today announces that it is changing its 1987 policy on evaluating clean closure under RCRA to allow use of fate and transport models to support clean closure demonstrations. EPA intends to publish this change in the Federal Register in the near future.

We encourage you to consider risk-based approaches when developing cleanup levels for RCRA regulated units and to give consideration to levels set by state/tribal programs which use risk-based approaches. EPA is developing guidance on risk-based clean closure and on the use of models to meet the clean closure performance standard.

Since almost all states oversee the closure/post-closure process and more than half implement RCRA corrective action, coordination of RCRA corrective action and closure will often be solely a state issue. However, if a state is not authorized for corrective action, or if a facility is subject to CERCLA as well as RCRA corrective action, close coordination between federal and state agencies will be necessary. As discussed above, actual approaches to coordination or deferral at any site should be developed in consideration of site-specific and community concerns.

<u>Summary</u>

We encourage you to continue your efforts to coordinate activities between the RCRA and CERCLA programs and between state, tribal and federal cleanup programs. We are aware that several of the EPA Regions are considering developing formal mechanisms to ensure that coordination will occur among these programs. We endorse these efforts and encourage all Regions, states and tribes to consider the adoption of mechanisms or policies to ensure coordination. If you have any questions on the issues discussed in this memorandum, or on other RCRA/CERCLA issues, please call Hugh Davis at (703) 308-8633.

attachments

cc: Craig Hooks, FFEO
Barry Breen, OSRE
Robert Van Heuvelen, ORE
Steve Luftig, OERR
Michael Shapiro, OSW
Jim Woolford, FFRRO
Regional RCRA Branch Chiefs
Regional CERCLA Branch Chiefs
Federal Facilities Leadership Council
Tom Kennedy, Association of States and Territorial Solid Waste Management Officials

Robert Roberts, Environmental Council of States
John Thomasian, National Governors Association
Brian Zwit, National Association of Attorneys General

Appendix D

APPENDIX D

EPA GROUNDWATER MONITORING REDUCTION CORRESPONDENCE

United States Environmental Protection Agency
Region 10
1200 Sixth Avenue
Seattle WA 98101
Alaska
Idaho
Oregon
Washington

000936

EPA

June 13, 1995

JUN 1995
Received
Environmental
Department/FMC

Reply to
Attn. of: HW-106

Mr J. David Buttelman
FMC Corporation
Phosphorous Chemicals Division
Pocatello, Idaho 83205

Re: Proposed RCRA Ground-Water Monitoring Reductions for the FMC Pocatello Facility, EPA ID# 07092 9518

Dear Mr. Buttelman:

In response to your May 22, 1995 letter, regarding a request for approval of a reduced analytical parameter list in your quarterly ground-water monitoring program the Environmental Protection Agency (Agency) has completed a technical review of the proposal. Under Part 265.93 (d) (4) and (7), the facility is responsible for determining the rate and extent of migration of the hazardous constituents in the groundwater and the concentrations of the waste constituents. The RCRA interim status ground-water program is largely self implementing. For this reason the Agency is unable to respond to requests for specific "approval" of your ground-water assessment plan components.

While the Agency does not offer specific approval of your proposed list, I would like to provide one technical comment. The reasons for eliminating parameters provided in your May 22 letter are similar to those developed in depth during previous meetings. With the exception of those arguments pertaining to cadmium, the reasons given are generally acceptable to the Agency. However, I believe FMC ought to consider retaining cadmium because it is a major component of your waste streams and could be reasonably expected to be present in site ground water. Acting within a technical support role, the Agency recommends that cadmium remain on the proposed analyte list.

The proposed analyte list is a significant reduction from 34 inorganic parameters and 4 radiological parameters to 10 inorganic parameters with no radiological parameters. The Agency agrees that this reduction appears appropriate at this stage of site characterization. It is, however, possible that FMC will further refine the conceptual model for the complex hydrogeologic system under study at this site. As this occurs, the facility may select additional parameters to be added to the list and should not hesitate to do so.

FMC Pocatello RCRA Analyte List, amended as discussed above:

Heavy Metals -- Arsenic, Cadmium, and Selenium
Water Quality -- Chloride, Fluoride, Potassium, Sulfate, Ammonia, Nitrate, and Orthophosphate
Field Parameters -- pH, Turbidity, Temperature and Specific Conductance

Should you have any questions or comments regarding this letter, or the effect of this program with regard to your site, please feel free to contact me at (206) 553-1262.

Sincerely,

Curt Black, Hydrogeologist
RCRA Permits Team
Hazardous Waste Division

cc: Sylvia Burges
Bill Adams
Mark Masarik, Idaho Operations Office

FMC Corporation

Phosphorus Chemicals Division
Box 4111
Pocatello, Idaho 83205
(208) 236-8200
FAX (208) 236-8396

FMC

May 22, 1995

Mr. Curt Black
M/S HW-106
U.S. EPA, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

Subject: Proposed RCRA Groundwater Monitoring Reductions for the FMC Pocatello Facility

Dear Mr. Black:

FMC requests EPA's approval to reduce the RCRA groundwater analytical program from the current list of 37 inorganic parameters and four radiological parameters to 9 inorganic parameters and no radiological parameters (Table 1). The proposed parameters to be retained for continued groundwater monitoring are as follows: ammonia, arsenic, selenium, orthophosphate, nitrate, chloride, potassium, sulfate, and fluoride. The rationale for this request stems largely from the fact that FMC RCRA WMUs subject to RCRA groundwater monitoring requirements manage wastes containing higher (compared to groundwater) concentrations of mobile common ions, such as sulfate, chloride, and potassium. Any leak detection program should utilize the most mobile and highest concentration parameters to increase the likelihood of leak detection. That is why FMC proposes using sulfate and potassium as the primary parameters, while chloride would be a secondary parameter. Chloride is proposed as a secondary indicator parameter because it has a high variability in background concentrations, reducing its usefulness as a statistical indicator.

Fluoride is proposed as an indicator parameter because the CERCLA Remedial Investigation (RI) data indicate that it is mobile through the vadose zone, and it is present at higher concentrations in the subject WMU liquids. This makes fluoride a reasonable indicator parameter, even though CERCLA RI data show fluoride is attenuated once introduced into the saturated zone. Arsenic, nitrate, selenium, orthophosphate, and ammonia are key CERCLA RI-related parameters that we propose to continue monitoring as RCRA parameters to assess the rate and extent of migration of these constituents in the aquifer. Arsenic, nitrate, and selenium represent constituents that are not rapidly attenuated in the aquifer system and are of concern. Orthophosphate and ammonia will provide information associated with former Pond 8S (WMU #7) and any associated changes in groundwater quality from ongoing closure activities.

It should be noted that, although cadmium is a primary constituent of concern in the subject waste, it has been excluded from this proposed analyte list because it has not been detected at mean concentrations in any FMC monitoring wells above the representative (background) groundwater concentrations. Furthermore, RI data indicate that cadmium has a very low mobility within the vadose zone reducing the potential for migration to groundwater.

The field parameters of pH, turbidity, temperature, and specific conductance will remain as standard data collection parameters.

In summary, the parameters selected will provide the best indication of improving or degrading groundwater quality associated with the RCRA WMUs and also provide a good dataset for assessing the overall extent and rate of migration.

FMC is currently monitoring groundwater at subject WMUs under interim status. This program consists of quarterly sampling in 26 RCRA monitoring wells, in conjunction with semi-annual monitoring of 27 CERCLA monitoring wells (Table 2).

FMC requests that EPA respond to this proposal prior to initiation of the June 1995 sampling event. Please contact John Schaffer of Bechtel Environmental, Inc. at (415) 768-1111, or Bob Hart of FMC at (208) 236-8374 if you have any comments or questions on this proposal. We look forward to your visit in June to review the monitor well sites and discuss the need for additional monitor wells.

Sincerely yours,

J. David Buttelman
Health, Safety, & Environmental Manager

Attachments

cc: R. R. Hosking
P. S. French
R. E. Hart
D. M. Heineck
P. H. Zeh

Table 1
Current and Proposed RCRA Analytes

RCRA Analytes			Proposed RCRA Analytes		
Heavy Metals	Water Quality	Radioactivity	Heavy Metals	Water Quality	Radioactivity
aluminum	alkalinity (bicarbonate)	gross alpha	arsenic	chloride	NONE
antimony	alkalinity (carbonate)	gross beta	selenium	fluoride*	
arsenic	ammonia	radium 226		potassium	
barium	calcium	radium 228		sulfate	
beryllium	chloride			ammonia	
boron	fluoride			nitrate	
cadmium	magnesium			orthophosphate	
chromium	nitrate				
cobalt	phosphorus (total)		2	7	
copper	phosphorus (orthophosphate)				
iron	potassium				
lead	sodium				
lithium	sulfate				
manganese	total dissolved solids				
mercury	total suspended solids				
molybdenum					
nickel					
selenium					
silver					
thallium					
vanadium					
zinc					
22	15	4			

Note: CERCLA parameter list is similar to proposed RCRA list, except fluoride is not a CERCLA parameter.

Table 2
RCRA and CERCLA Monitoring Wells

RCRA Wells			CERCLA Wells		
101	123	148	111	161	TW-12S
104	124	149	134	164	TW-11S
108	126	150	136	502	
113	127	152	140	515	
114	128	154	142	523	
115	130	158	143	524	
116	131		146	525	
118	132		151	Old Pilot House	
121	137		159	TW-9S	
122	147				

Note: RCRA Wells are sampled quarterly.

Note: These CERCLA Wells are sampled semi-annually by FMC. Other CERCLA Wells not on this list are sampled by Simplot.

Appendix E

APPENDIX E

FIELD SAMPLING PLAN FOR EQUIPMENT DECONTAMINATION CONFIRMATION DURING RCRA POND CLOSURES

Table of Contents

TABLES

Field Sampling Plan for Equipment Decontamination Confirmation during RCRA Pond Closures

1. INTRODUCTION

This Field Sampling Plan (FSP) provides sampling and analysis procedures for equipment or material decontamination confirmation samples collected during RCRA closure of ponds located at the FMC Elemental Phosphorus Plant in Pocatello, Idaho. This plan will be implemented by the FMC Remediation Project Manager or his designee, who is also responsible for reviewing, reporting, and archiving the data gathered in accordance with this plan.

Closure of the ponds will be conducted in accordance with the procedures described in the respective closure plans. The closure plans propose closing the various ponds with waste in place, pursuant to 40 CFR §265.228(a)(2) except Pond 18 Cell B which will be closed by removal pursuant to 40 CFR §265.228(a)(1).

Closure of the ponds will require that potentially contaminated equipment or materials be decontaminated prior to leaving the site. Based on criteria specified in the closure plans, confirmation samples from the final wash will be collected and analyzed for verification of decontamination.

This FSP contains procedures for equipment or material decontamination confirmation sample collection, labeling, storage, shipment, chain-of-custody protocols, and quality assurance/quality control (QA/QC). The plan also specifies the analytical parameters, test methods, and threshold concentrations. Implementation of these procedures will ensure that equipment or material that have come into contact with hazardous waste has been properly decontaminated prior to leaving the site.

2. ANALYTICAL PARAMETERS

Samples collected will be analyzed for total phosphorus and the following metals that are specified in 40 CFR §261.24:

- Arsenic (As)
- Barium (Ba)
- Cadmium (Cd)
- Chromium (Cr)
- Lead (Pb)

- Mercury (Hg)
- Selenium (Se)
- Silver (Ag)

3. SAMPLING OBJECTIVES

The objective of sampling and analyzing final decontamination wash water is to verify that the equipment or material has been thoroughly decontaminated. Equipment or materials will be considered decontaminated if it is free of residual dirt and debris and if levels of toxicity characteristic metals in the final wash water are less than the limits specified in 40 CFR §261.24. Table E-1 presents the data quality objectives for decontamination confirmation sampling and analysis.

TABLE E-1 DATA QUALITY OBJECTIVES (DQOs)

DQO Step[1]	Objective
State the Problem	Equipment or materials used and/or encountered during pond closure activities must be decontaminated prior to leaving the site or moving to another WMU within the facility.
Identify the Decision	Has the equipment or material been sufficiently decontaminated to prevent transport of potentially contaminated material off site or to adjacent WMU?
Identify the Inputs to the Decision	• Visual inspection of the equipment or material • Results from TCLP metals analysis of final wash water poured over the decontaminated equipment or material • Results from total phosphorus analysis of final wash water poured over the decontaminated equipment or material
Define the Boundaries of the Study	Confirmation of equipment or material decontamination will be conducted during the closure of each pond. Confirmation sampling will be conducted in the contaminant reduction zone associated with each pond closure.
Develop a Decision Rule	If visual inspection indicates the equipment or material is decontaminated, then a sample of the final wash water will be collected for total metals and total phosphorus analysis. If the total metals concentrations are less than the toxicity characteristic limits specified in 40 CFR. 261.24, then the decontamination of the equipment or material has been confirmed.
Specify Tolerable Limits on Decision Errors	Analytical QA objectives are specified in Table E-4 for TCLP metals and total phosphorus in the rinsate samples. A non-quantifiable visual inspection and judgmental sampling approach is is used for elemental phosphorus.
Optimize the Design for Obtaining Data	The visual inspection and judgmental sampling approach is designed to limit the possibility of concluding the equipment or material is decontaminated when in fact it is not.

(1) Guidance for the Data Quality Objectives Process, EPA QA/G-4 August 2000.

4. SAMPLING LOCATIONS AND FREQUENCY

Decontamination wash water samples and distilled water blank samples will be collected within the designated decontamination area. The sample volume collected will be sufficient for analyzing laboratory control samples.

4.1 Decontamination Wash Water Samples

Equipment or material must be decontaminated prior to moving onto the site, between locations on the site, and prior to leaving the site. Decontamination is required for all equipment or material components that may have contacted the waste. The equipment operator should take steps to prevent contamination of the equipment interiors. Decontamination may also be required to parts of the equipment that become splattered with soil and/or waste material. Equipment or material decontamination should be conducted on decontamination pads or in designated decontamination areas located close enough to the work area that contamination is not spread during the movement of the equipment or material. Gross contamination should be removed at the work site prior to moving the equipment or material to the decontamination area. Decontamination will consist of a high-pressure water wash with well water or industrial wastewater.

One decontamination confirmation water sample using distilled or de-ionized water will be collected after the final round of equipment or material rinsing in accordance with the procedures specified in Section 6. Each sample will be submitted to the laboratory in accordance with the procedures specified in Section 7.

4.2 De-Ionized Water Blank Samples

De-ionized water blank samples will be collected, when appropriate, during closure operations in accordance with the procedures specified in Section 5. A minimum of one sample per delivery group will be collected. Each blank sample will be submitted to the laboratory in accordance with the procedures specified in Section 6.

4.3 Laboratory Quality Control Samples

Sufficient sample volume for laboratory quality control samples will also be collected at a frequency of one per sample delivery group or one per twenty samples collected in accordance with the procedures specified in Section 6. Each sample will be submitted to the laboratory in accordance with the procedures specified in Section 7.

5. SAMPLE DESIGNATION

All samples collected will be labeled in a clear and precise way for proper identification in the field and for tracking in the laboratory. The samples will have preassigned, identifiable, and unique numbers. At a minimum, the sample labels will contain the following information:

- Facility name
- Station location/sample number
- Date of collection
- Time of collection
- Analytical parameter
- Method of preservation.

Every sample, including samples collected from a single location but going to separate laboratories, will be assigned a unique sample number. The uniqueness of the sample number will be assured by the combination of sample location and date of collection.

For decontamination final wash water, the facility location indicated on the sample label will be the name of the waste management unit (e.g., Pond 8E) being closed. The station location will be described as follows in a manner consistent with the conventions used during the remedial investigation:

- A three-letter designation will be used as a general facility identification. The site code for the FMC site is:

  FMC

- A two-letter code will be used to identify the sample matrix. These matrix codes are designated as follows:

  WW - Waste Water

- A three-digit or descriptive letter combination will be used to identify the location from which a sample is collected. Samples collected for field QC will be identified by a three-digit or descriptive letter combination. Numbers for locations and field QC will be grouped as follows:

  Decontamination final wash Water: 800 series starting with 800 for each sampling event and continuing consecutively during the event for each sample collected.

  Field DI Blank: FDI

The date of collection will be indicated in mm/dd/yy format and the time will be indicated in accordance with the military convention. The analytical parameter and method of preservation will be indicated in an unambiguous short hand, such as F^- for fluoride.

6. SAMPLING EQUIPMENT AND PROCEDURES

This section describes the procedures to be used to collect decontamination final wash water samples. All samples will be collected in accordance with the procedures presented in this section and handled in accordance with the procedures presented in Section 7.

6.1 Field Logbooks

Field logbooks will document where, when, how, and from whom any vital project information was obtained. Logbook entries will be complete and accurate enough to permit reconstruction of field activities. At a minimum, the following sampling information will be recorded:

- Site sketch
- Sample location and description
- Sampler's name(s)
- Date and time of sample collection
- Designation of sample as a grab sample
- Type of sample (i.e., wash water)
- Type of sampling equipment used

- Field observations and details important to analysis or integrity of samples (e.g., heavy rains, odors, colors, etc.)
- Type of preservation used
- Lot numbers of the sample containers, sample tag numbers, chain-of-custody form numbers, and chain-of-custody seal numbers
- Shipping arrangements (Federal Express air bill number)
- Recipient laboratory(ies).

Logbooks will be bound with consecutively numbered pages and be rain-resistant. Each page will be dated and the time of entry noted in military time. All entries will be legible, written in waterproof black ink, and signed by the individual making the entries. Language will be factual, objective, and free of personal opinions or other terminology that might prove inappropriate. In addition to the sampling information, the following specifics will also be recorded in the field logbook:

- Team members and their responsibilities
- Time of site arrival/entry on site and time of site departure
- Other personnel on site
- A summary of any meetings or discussions with any FMC personnel, or federal, state, or other regulatory agencies
- Any deviations from the sampling plan and site safety plan procedures
- Any changes in personnel and responsibilities as well as reasons for the changes
- Levels of safety protection

6.2 Decontamination Wash Water Sample Collection

Representative decontamination wash water samples will be collected after the last round of equipment or material rinsing. A portion of wash water using distilled or de-ionized water will be collected directly into a polyethylene bottle(s) by holding the bottle under the water stream as it flows over the equipment or material.

6.3 De-Ionized Water Blank Sample Collection

De-ionized water blank samples will be collected by pouring de-ionized water from the container it is received in, into a polyethylene bottle in the decontamination area.

6.4 Laboratory QA/QC Sample Collection

When collecting additional sample volume for laboratory QA/QC samples, a single sample designation will be assigned to a double volume sample.

6.5 Sampling Equipment Decontamination Procedure

No specialized sampling equipment is required to conduct equipment or material final wash water sample collection. Samples are collected directly into sample bottles from the decontamination water stream as it flows off the equipment or material of interest.

7. SAMPLE HANDLING AND ANALYSIS

This section describes sample handling procedures including sample containers, sample preservation, shipping requirements and holding times, and sample analysis. These procedures are designed to ensure that samples are preserved and transported to the laboratory in a manner that is consistent and maintains sample integrity. Table E-2 summarizes sample containers, preservatives, volume, and holding times.

TABLE E-2 SAMPLE HANDLING AND PRESERVATION PROCEDURES

Parameter	Recommended Container	Preservative	Maximum Holding Time
Total Phosphorus	1 0.5-liter polyethylene bottle	2 ml of conc. H_2SO_4 per liter, cool to 4°C	14 days
RCRA Toxicity Characteristic Metals (As, Ba, Cd, Cr, Pb, Hg, Se, Ag)	2 0.5–liter polyethylene bottles	HNO_3 to pH<2, Cool to 4°C	6 months

7.1 Sample Handling

Sample containers will be pre-cleaned and will not be rinsed prior to sample collection. Preservatives, if required, will be added to the containers prior to shipment of the sample containers to the laboratory. Following collection, samples will be properly stored to prevent degradation of the integrity of the sample prior to its analysis.

7.2 Sample Shipment

All sample containers will be placed in a strong, ice chest for shipping. The following outlines the packaging procedures that will be followed.

1. When ice is used, secure the drain plug of the cooler with fiberglass tape to prevent melting ice from leaking out of the cooler.
2. Line the bottom of the cooler with bubble wrap to prevent breakage during shipment.
3. Check screw caps for tightness and, if not full, mark the sample volume level of liquid samples on the outside of their sample bottles with indelible ink.
4. Secure bottle/container tops with strapping tape and custody-seal all container tops.
5. Affix sample labels onto the containers with clear tape.
6. Seal all sample containers in heavy-duty plastic bags. Write the sample numbers on the outside of the plastic bags with indelible ink.

All samples will be placed in coolers with the appropriate chain-of-custody form. All forms will be enclosed in a large plastic bag and affixed to the underside of the cooler lid. Empty space in the cooler will be filled with bubble wrap or styrofoam peanuts to prevent movement and breakage during shipment. Vermiculite will also be placed in the cooler to absorb spills if they occur. Ice used to cool samples will be double-sealed in two zip-lock plastic bags and placed on top and around the samples to chill them to the correct temperature. Each ice chest will be securely taped shut with nylon strapping tape, and custody seals will be affixed over the front, right, and back sides of each cooler lid.

7.3 Sample Analysis

The analytical methods that will be used for this program are specified in Table E-3. The table specifies the parameters to be analyzed, analytical method number and type, method detection limit (MDL), and maximum concentration for the toxicity characteristic. MDLs presented on these tables for each analysis represent the best reporting limits that can be attained by the specified methodology. Overall (sampling plus analytical) precision goal, overall accuracy goal, and overall completeness goal are presented in Table E-4.

TABLE E-3 SUMMARY OF REQUIRED ANALYSES

Parameter	Method Number	Method Type	Method Detection Limit (ppm)	Maximum Concentration for the Toxicity Characteristic (ppm)
Arsenic	6010B (a)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.0003–0.075	5.0
Barium	6010B (a)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.0003–0.075	100.0
Cadmium	6010B (a)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.0003–0.075	1.0
Chromium	6010B (a)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.0003–0.075	5.0
Lead	6010B (a)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.0003–0.075	5.0
Mercury	7470A (a)	Manual Cold Vapor Technique	0.0002	0.2
Total Phosphorus	365.4(b)	Colorimetric	0.01	NA
Selenium	6010B (a)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.0003–0.075	1.0
Silver	6010B (a)	Inductively Coupled Plasma Atomic Emission Spectrometry	0.0003–0.075	5.0

(a) Test Method for Evaluating Solid Waste, EPA SW–846, third Edition, Update III, December 1996.

(b) Methods for Chemical Analysis of Waste and Wastes, EPA-600/4-79-020, Revision March 1983.

TABLE E-4 ANALYTICAL QUALITY ASSURANCE OBJECTIVES

Parameter	Precision	Accuracy	Completeness
Arsenic	± 35	70 - 130%	90%
Barium	± 35	70 - 130%	90%
Cadmium	± 35	70 - 130%	90%
Chromium	± 35	70 - 130%	90%
Lead	± 35	70 - 130%	90%
Mercury	± 35	70 - 130%	90%
Total Phosphorus	± 35	70 - 130%	90%
Selenium	± 35	70 - 130%	90%
Silver	± 35	70 - 130%	90%

For method-specific QC criteria and samples (e.g., calibration blanks or initial calibrations), the criteria specified in the methods will be used. The methods will be performed as written. Any deviations, if allowed, must be approved by FMC in writing prior to implementation by the laboratory. Laboratory procedures will be in place for demonstrating that the laboratory is in control during each analytical measurement.

8. DISPOSAL OF WASTE

In the process of collecting decontamination final wash water samples, two types of potentially contaminated wastes will be generated. The expected wastes are the following:

- Used personal protective equipment (PPE)
- Decontamination fluids.

The following section describes the procedures that will be followed to handle these wastes. The procedures have enough flexibility to allow the sampling team to use its professional judgment on the proper method for the disposal of each type of waste generated at each sampling location.

8.1 Used Personal Protective Equipment

Used PPE will be double-bagged and placed in a non-hazardous refuse dumpster. These wastes are not hazardous and can be sent to a municipal landfill. Any PPE that is to be disposed of which can still be reused will be rendered inoperable before disposal in the refuse dumpster.

8.2 Equipment or Material Decontamination Fluids

Any hazardous wastes generated from closure equipment or material decontamination may be treated on-site or otherwise managed in accordance with RCRA requirements. If necessary, such waste will be temporarily stored at the closure area in accordance with Section 8.11.1 of this closure plan. No listed hazardous waste relating to closure activity is anticipated at the facility. If transporation to a hazardous waste facility is required, hazardous waste manifest procedures will be followed in accordance with 40 C.F.R. §262.20.

9 REFERENCES

EPA, 1983. Methods for Chemical Analysis of Water and wastes, EPA 600/4-79-020, revised March 1983.

EPA, 1986. NEIC Policies and Procedures, National Enforcement Investigations Center, Denver, Colorado, revised May 1986.

EPA, 1993. Test Methods for Evaluating Solid Waste, EPA SW-846, Third Edition, Office of Solid Waste and Emergency Response, Washington, DC, update III, December 1996.

EPA, 2000. Guidance for the Data Quality Objectives Process, EPA QA/G-4, EPA/600/R-96/055. Office of Research and Development. Washington D.C. August 2000.

Appendix F

APPENDIX F

GROUNDWATER CHEMISTRY STATISTICS FOR PHASE IV PONDS

PHASE IV PONDS

Waste Management Unit 8

Note:

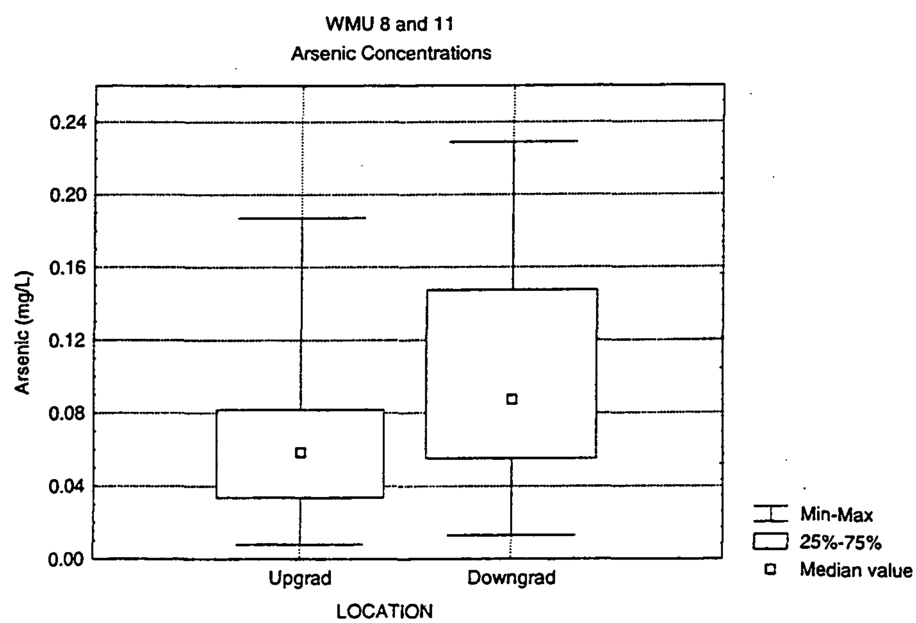
1. Time series plot scales are variable depending on the concentrations.
2. Undetected values are not plotted on time series plots.

WMU 8 and 11 -- TEST 1 -- ARSENIC

STAT. NONPAR STATS	Mann-Whitney U Test (wmu8-as.sta) By variable LOCATION Group 1: 1-Upgrad Group 2: 2-Downgrad					
variable	Rank Sum Upgrad	Rank Sum Downgrad	U	Z	p-level	Z adjusted
AS_CONC	6096.000	19555.00	3321.000	-4.99268	.000001	-4.99294

STAT. NONPAR STATS	Mann-Whitney U Test (wmu8-as.sta) By variable LOCATION Group 1: 1-Upgrad Group 2: 2-Downgrad		
variable	p-level	Valid N Upgrad	Valid N Downgrad
AS_CONC	.000001	74	152

Summary: Downgradient wells have statistically higher arsenic concentrations than upgradient wells.



TEST 2

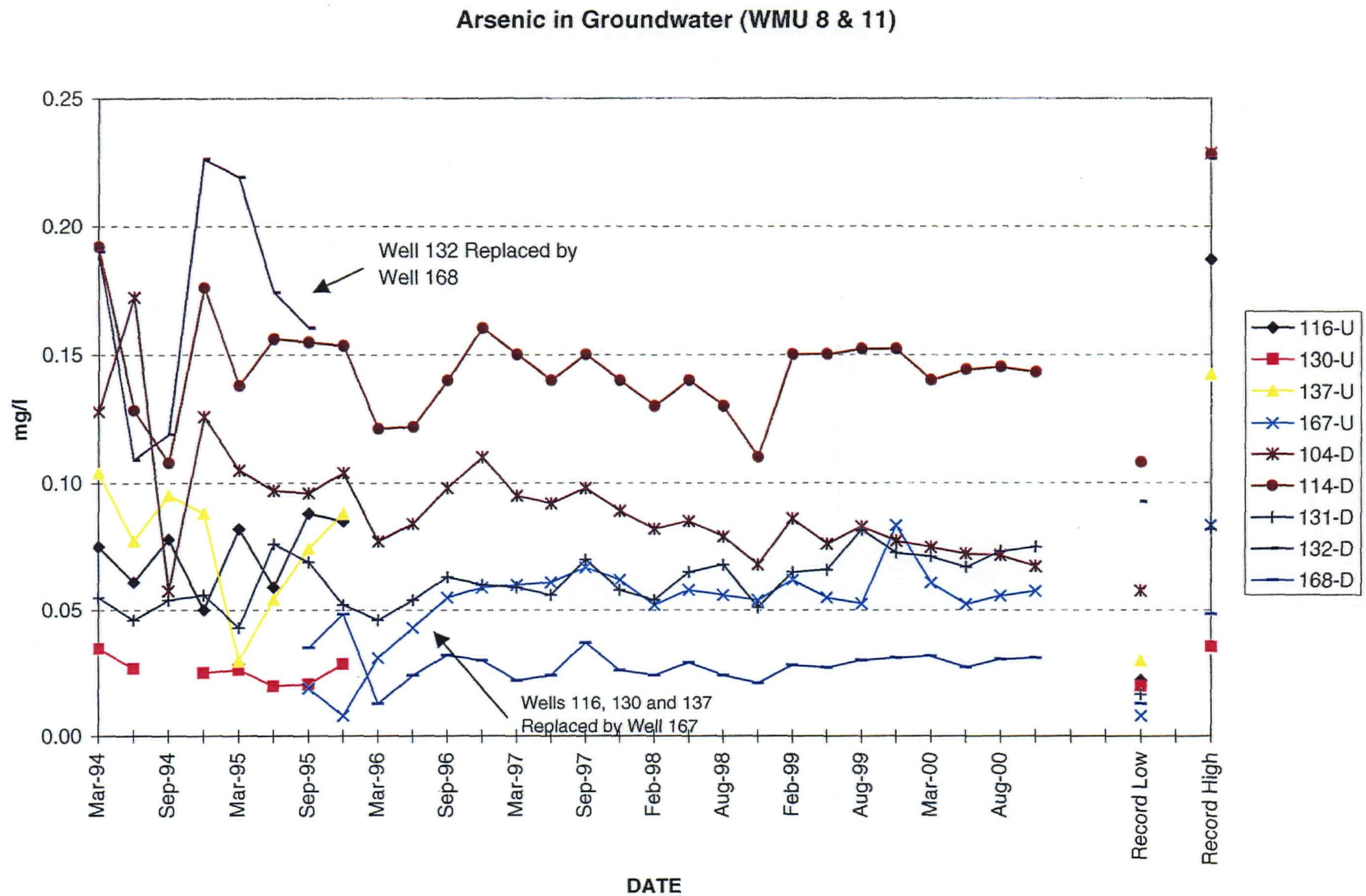
STATISTICS FOR PHASE IV PONDS & POND 8E (WMU 8 AND 11)

Arsenic

	Upgradient Wells				Downgradient Wells				
Date	Well 116	Well 130	Well 137	Well 167	Well 104	Well 114	Well 131	Well 132	Well 168
Sep-91	**0.046**	**0.029**	**0.108**	N.S.	0.092	0.175	0.043	0.131	N.S.
Dec-91	**0.069**	**0.030**	**0.092**	N.S.	0.098	0.178	0.045	0.141	N.S.
Mar-92	**0.068**	**0.034**	**0.140**	N.S.	0.081	0.184	0.059	0.182	N.S.
Jun-92	**0.071**	**0.029**	U	N.S.	0.212	0.195	0.048	U	N.S.
Sep-92	**0.022**	**0.034**	**0.101**	N.S.	0.229	0.154	0.052	0.194	N.S.
Dec-92	**0.187**	**0.031**	**0.118**	N.S.	0.180	0.179	0.047	0.164	N.S.
Mar-93	**0.056**	**0.035**	**0.093**	N.S.	0.164	0.120	0.058	0.225	N.S.
Jun-93	**0.083**	**0.028**	**0.107**	N.S.	0.164	0.182	0.047	0.179	N.S.
Sep-93	**0.076**	**0.027**	**0.082**	N.S.	0.127	0.202	0.055	0.168	N.S.
Dec-93	**0.077**	**0.027**	**0.091**	N.S.	0.122	0.172	0.054	0.143	N.S.
Mar-94	**0.075**	**0.035**	**0.104**	N.S.	0.128	0.192	0.055	0.190	N.S.
Jun-94	**0.061**	**0.027**	**0.077**	N.S.	0.172	0.128	0.046	0.109	N.S.
Sep-94	**0.078**	U	**0.095**	N.S.	0.058	0.108	0.054	0.119	N.S.
Dec-94	**0.050**	**0.025**	**0.088**	N.S.	0.126	0.176	0.056	0.226	N.S.
Mar-95	**0.082**	**0.026**	**0.030**	N.S.	0.105	0.138	0.043	0.219	N.S.
Jun-95	**0.059**	**0.020**	**0.054**	N.S.	0.097	0.156	0.076	0.174	N.S.
Sep-95	**0.088**	**0.020**	**0.074**	**0.019**	0.096	0.155	0.069	0.160	0.035
Dec-95	**0.085**	**0.028**	**0.088**	**0.008**	0.104	0.153	0.052	N.S.	0.048
Mar-96	N.S.	N.S.	N.S.	**0.031**	0.077	0.121	0.046	N.S.	0.013
Jun-96	N.S.	N.S.	N.S.	**0.043**	0.084	0.122	0.054	N.S.	0.024
Sep-96	N.S.	N.S.	N.S.	**0.055**	0.098	0.140	0.063	N.S.	0.032
Dec-96	N.S.	N.S.	N.S.	**0.059**	0.110	0.160	0.060	N.S.	0.030
Mar-97	N.S.	N.S.	N.S.	**0.060**	0.095	0.150	0.059	N.S.	0.022
Jun-97	N.S.	N.S.	N.S.	**0.061**	0.092	0.140	0.056	N.S.	0.024
Sep-97	N.S.	N.S.	N.S.	**0.067**	0.098	0.150	0.070	N.S.	0.037
Dec-97	N.S.	N.S.	N.S.	**0.062**	0.089	0.140	0.058	N.S.	0.026
Feb-98	N.S.	N.S.	N.S.	**0.052**	0.082	0.13	0.054	N.S.	0.024
May-98	N.S.	N.S.	N.S.	**0.058**	0.085	0.14	0.065	N.S.	0.029
Aug-98	N.S.	N.S.	N.S.	**0.056**	0.079	0.13	0.068	N.S.	0.024
Nov-98	N.S.	N.S.	N.S.	**0.054**	0.068	0.11	0.051	N.S.	0.021
Feb-99	N.S.	N.S.	N.S.	**0.062**	0.086	0.15	0.065	N.S.	0.028
May-99	N.S.	N.S.	N.S.	**0.055**	0.076	0.15	0.066	N.S.	0.027
Aug-99	N.S.	N.S.	N.S.	**0.0525**	0.0828	0.152	0.0817	N.S.	0.03
Nov-99	N.S.	N.S.	N.S.	**0.0834**	0.0772	0.152	0.0726	N.S.	0.0309
Mar-00	*N.S.*	*N.S.*	*N.S.*	***0.0609***	*0.0747*	*0.14*	*0.0712*	*N.S.*	*0.0317*
May-00	*N.S.*	*N.S.*	*N.S.*	***0.0523***	*0.0722*	*0.144*	*0.0669*	*N.S.*	*0.0272*
Aug-00	*N.S.*	*N.S.*	*N.S.*	***0.0557***	*0.0716*	*0.145*	*0.0731*	*N.S.*	*0.0304*
Nov-00	*N.S.*	*N.S.*	*N.S.*	***0.0575***	*0.0672*	*0.143*	*0.0749*	*N.S.*	*0.031*

	Well 116	Well 130	Well 137	Well 167	Well 104	Well 114	Well 131	Well 132	Well 168
Pre-2000 Mean	**0.074**	**0.028**	**0.091**	**0.052**	0.110	0.152	0.057	0.170	0.028
2000 Mean	**#N/A**	**#N/A**	**#N/A**	**0.057**	0.071	0.143	0.072	#N/A	0.030
1991-2000 Summary									
Mean	0.074	0.028	0.091	0.053	0.106	0.151	0.059	0.170	0.028
Standard Error	0.008	0.001	0.006	0.003	0.007	0.004	0.002	0.009	0.001
Median	0.073	0.028	0.092	0.056	0.094	0.150	0.057	0.171	0.029
Mode	#N/A	#N/A	0.088	0.055	0.098	0.140	0.054	#N/A	0.024
Standard Deviation	0.033	0.004	0.025	0.016	0.040	0.023	0.010	0.036	0.007
Sample Variance	0.001	0.000	0.001	0.000	0.002	0.001	0.000	0.001	0.000
Kurtosis	9.034	-0.107	1.910	2.980	2.051	-0.387	-0.767	-0.743	3.015
Skewness	2.392	-0.322	-0.613	-1.382	1.589	0.303	0.334	0.009	0.645
Range	0.165	0.016	0.110	0.075	0.171	0.094	0.039	0.117	0.035
Minimum	0.022	0.020	0.030	0.008	0.058	0.108	0.043	0.109	0.013
Maximum	0.187	0.035	0.140	0.083	0.229	0.202	0.082	0.226	0.048
Sum	1.333	0.484	1.542	1.164	4.020	5.755	2.234	2.724	0.625
Count	18	17	17	22	38	38	38	16	22

U = Not Detected; #N/A = Value not calculated because of non-detect or not sampled values in data set.
N.S = Not Sampled, Upgradient well(s) in bold; 2000 data in italics.
All concentrations in mg/l.



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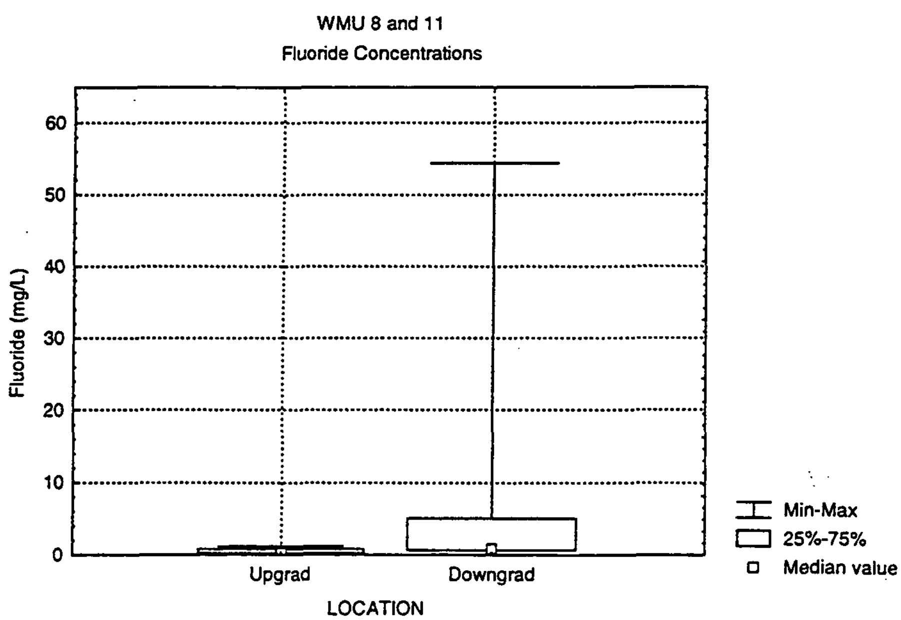
WMU 8 and 11 -- TEST 1 -- FLUORIDE

STAT. NONPAR STATS	Mann-Whitney U Test (wmu8-fl.sta) By variable LOCATION Group 1: 1-Upgrad Group 2: 2-Downgrad					
variable	Rank Sum Upgrad	Rank Sum Downgrad	U	Z	p-level	Z adjusted
FL_CONC	2568.500	13902.50	1343.500	-6.03596	.000000	-6.03883

STAT. NONPAR STATS	Mann-Whitney U Test (wmu8-fl.sta) By variable LOCATION Group 1: 1-Upgrad Group 2: 2-Downgrad		
variable	p-level	Valid N Upgrad	Valid N Downgrad
FL_CONC	.000000	49	132

Summary: Downgradient wells have statistically higher fluoride concentrations than upgradient wells.



TEST 2
STATISTICS FOR PHASE IV PONDS & POND 8E (WMU 8 AND 11)

Fluoride

	Upgradient Wells				Downgradient Wells				
Date	Well 116	Well 130	Well 137	Well 167	Well 104	Well 114	Well 131	Well 132	Well 168
Sep-91	0.900	0.300	0.200	N.S.	15.000	0.700	0.300	1.300	N.S.
Dec-91	1.210	0.280	0.200	N.S.	11.600	0.740	0.230	1.410	N.S.
Mar-92	1.230	0.260	0.200	N.S.	19.000	0.848	0.200	1.300	N.S.
Jun-92	1.070	0.251	0.134	N.S.	9.170	0.826	0.185	1.120	N.S.
Sep-92	0.900	0.200	0.100	N.S.	8.400	0.810	0.200	0.800	N.S.
Dec-92	1.100	0.300	0.200	N.S.	8.600	0.700	0.200	0.900	N.S.
Mar-93	1.000	0.300	0.100	N.S.	8.200	0.800	0.200	1.000	N.S.
Jun-93	0.900	0.300	0.200	N.S.	8.400	0.800	0.300	1.200	N.S.
Sep-93	0.800	0.300	U	N.S.	7.580	0.600	1.450	1.040	N.S.
Dec-93	0.800	0.300	U	N.S.	6.500	0.500	U	0.800	N.S.
Mar-94	0.800	0.356	U	N.S.	8.000	0.600	U	0.918	N.S.
Jun-94	0.900	0.300	U	N.S.	8.100	0.854	0.800	1.100	N.S.
Sep-94	0.800	0.300	0.200	N.S.	6.500	0.700	0.600	0.700	N.S.
Dec-94	0.500	0.300	U	N.S.	6.700	0.800	0.400	0.600	N.S.
Mar-95	0.602	0.284	U	N.S.	6.320	0.800	0.286	0.602	N.S.
Jun-95	0.602	0.240	U	N.S.	6.700	0.806	0.300	0.570	N.S.
Sep-95	0.610	0.332	U	0.360	6.920	0.872	U	0.600	54.400
Dec-95	0.436	U	U	0.236	4.940	0.490	U	N.S.	29.600
Mar-96	N.S.	N.S.	N.S.	U	6.200	U	U	N.S.	9.100
Jun-96	N.S.	N.S.	N.S.	0.324	5.100	0.670	0.284	N.S.	10.400
Sep-96	N.S.	N.S.	N.S.	U	6.040	U	U	N.S.	5.600
Dec-96	N.S.	N.S.	N.S.	0.370	5.560	0.610	0.100	N.S.	7.530
Mar-97	N.S.	N.S.	N.S.	0.100	5.300	0.660	0.180	N.S.	5.900
Jun-97	N.S.	N.S.	N.S.	U	4.900	0.610	0.100	N.S.	4.910
Sep-97	N.S.	N.S.	N.S.	U	4.700	0.530	U	N.S.	4.600
Dec-97	N.S.	N.S.	N.S.	U	4.850	0.630	U	N.S.	4.980
Feb-98	N.S.	N.S.	N.S.	U	5.3	0.69	U	N.S.	5.1
May-98	N.S.	N.S.	N.S.	U	4.9	0.66	U	N.S.	5
Aug-98	N.S.	N.S.	N.S.	U	4.6	0.75	U	N.S.	4.8
Nov-98	N.S.	N.S.	N.S.	U	4.9	0.82	U	N.S.	4.9
Feb-99	N.S.	N.S.	N.S.	U	5	0.8	0.13	N.S.	5
May-99	N.S.	N.S.	N.S.	U	4.4	0.86	0.27	N.S.	4.6
Aug-99	N.S.	N.S.	N.S.	U	4.6	0.75	0.14	N.S.	5
Nov-99	N.S.	N.S.	N.S.	U	U	U	U	N.S.	U
Mar-00	*N.S.*	*N.S.*	*N.S.*	*U*	*4.9*	*0.89*	*U*	*N.S.*	*5.5*
May-00	*N.S.*	*N.S.*	*N.S.*	*U*	*4.5*	*0.86*	*U*	*N.S.*	*U*
Aug-00	*N.S.*	*N.S.*	*N.S.*	*U*	*4.8*	*0.88*	*0.14*	*N.S.*	*5.5*
Nov-00	*N.S.*	*N.S.*	*N.S.*	*U*	*4.6*	*0.51*	*0.11*	*N.S.*	*5.3*

	Well 116	Well 130	Well 137	Well 167	Well 104	Well 114	Well 131	Well 132	Well 168
Pre-2000 Mean	0.842	0.288	0.170	0.278	7.060	0.719	0.326	0.939	10.084
2000 Mean	#N/A	#N/A	#N/A	#N/A	4.700	0.785	0.125	#N/A	5.433
1991-2000 Summary									
Mean	0.842	0.288	0.170	0.278	6.805	0.726	0.309	0.939	9.386
Standard Error	0.054	0.009	0.015	0.050	0.496	0.020	0.062	0.066	2.673
Median	0.850	0.300	0.200	0.324	6.040	0.750	0.200	0.918	5.200
Mode	0.900	0.300	0.200	#N/A	4.900	0.800	0.200	1.300	5.000
Standard Deviation	0.230	0.035	0.045	0.113	3.019	0.118	0.297	0.274	11.95
Sample Variance	0.053	0.001	0.002	0.013	9.112	0.014	0.088	0.075	142.9
Kurtosis	-0.651	1.740	-1.068	0.761	7.604	-0.819	10.13	-1.205	11.59
Skewness	-0.032	-0.754	-1.017	-1.250	2.531	-0.508	2.999	0.148	3.364
Range	0.794	0.156	0.100	0.270	14.60	0.400	1.350	0.840	49.80
Minimum	0.436	0.200	0.100	0.100	4.400	0.490	0.100	0.570	4.600
Maximum	1.230	0.356	0.200	0.370	19.00	0.890	1.450	1.410	54.40
Sum	15.16	4.903	1.534	1.390	251.8	25.43	7.105	15.96	187.7
Count	18	17	9	5	37	35	23	17	20

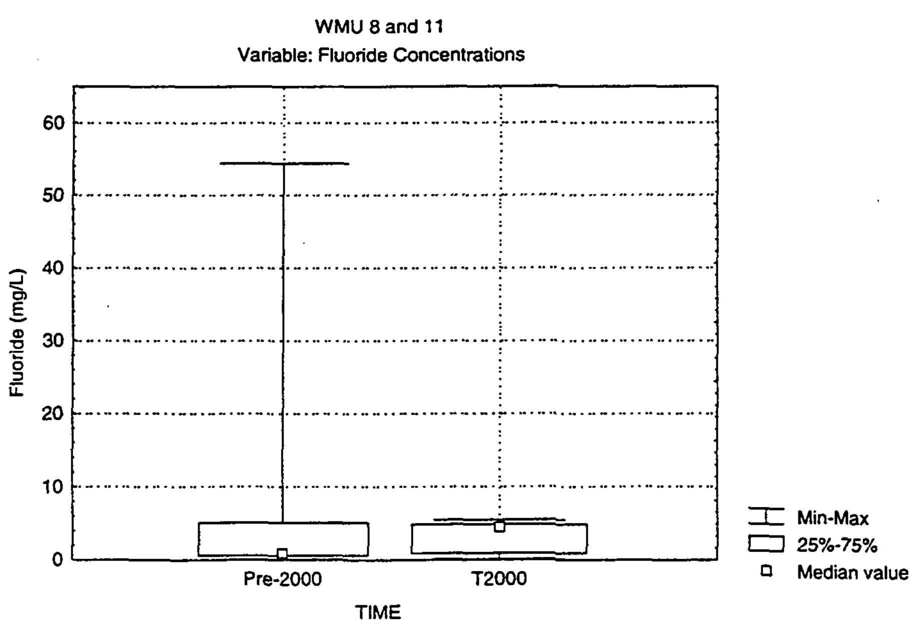
U = Not Detected; #N/A = Value not calculated because of non-detect or not sampled values in data set.
N.S = Not Sampled, Upgradient well(s) in bold; 2000 data in italics.
All concentrations in mg/l.

WMU 8 and 11 -- TEST 3 -- FLUORIDE

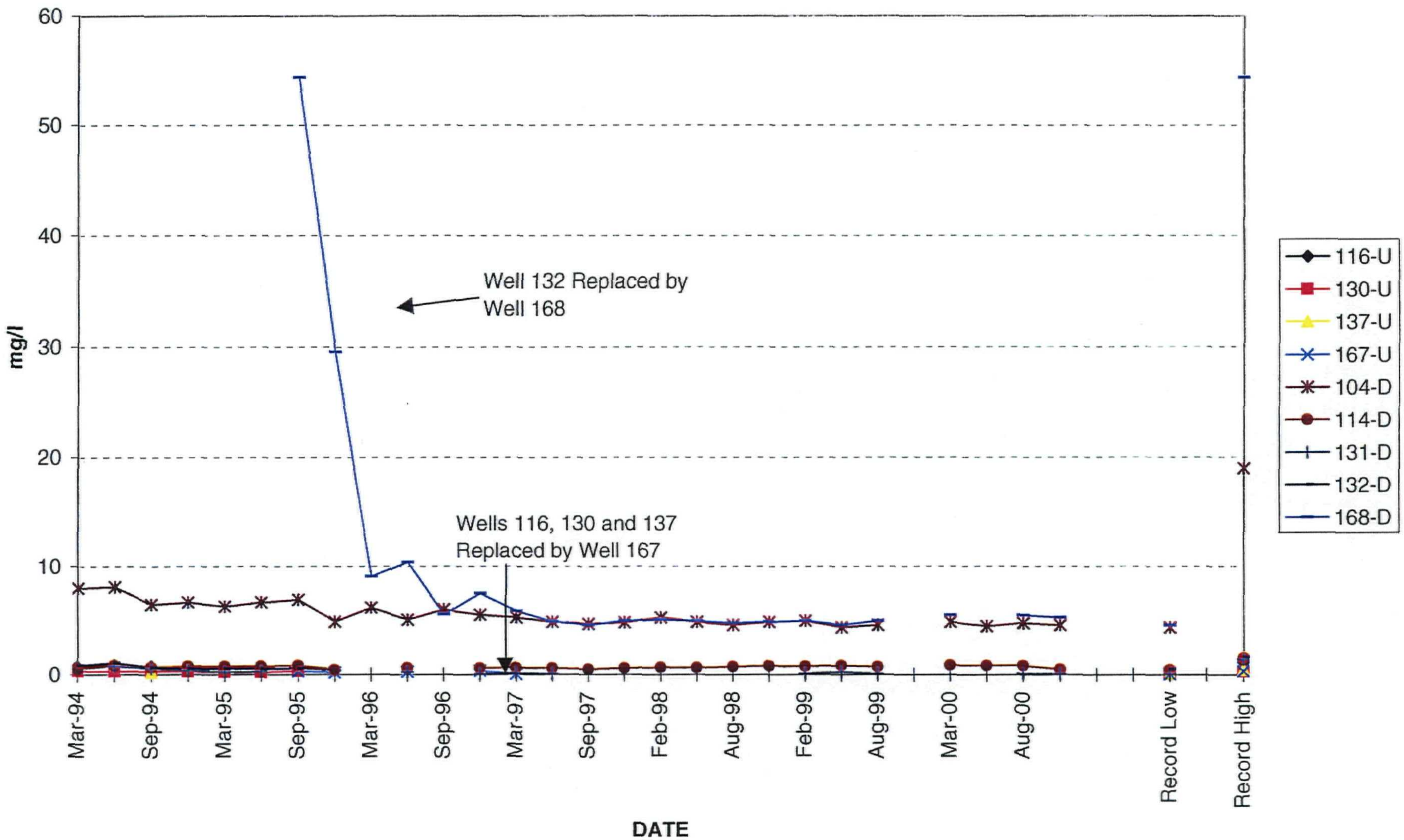
STAT. NONPAR STATS	Mann-Whitney U Test (wmu8fld.sta) By variable TIME Group 1: 3-Pre-2000 Group 2: 4-T2000					
variable	Rank Sum Pre-2000	Rank Sum T2000	U	Z	p-level	Z adjusted
FL_CONC	7917.500	860.5000	769.5000	-.030548	.975630	-.030556

STAT. NONPAR STATS	Mann-Whitney U Test (wmu8fld.sta) By variable TIME Group 1: 3-Pre-2000 Group 2: 4-T2000		
variable	p-level	Valid N Pre-2000	Valid N T2000
FL_CONC	.975624	119	13

Summary: Pre-2000 and 2000 fluoride data for downgradient wells are statistically the same.



Fluoride in Groundwater (WMU 8 & 11)

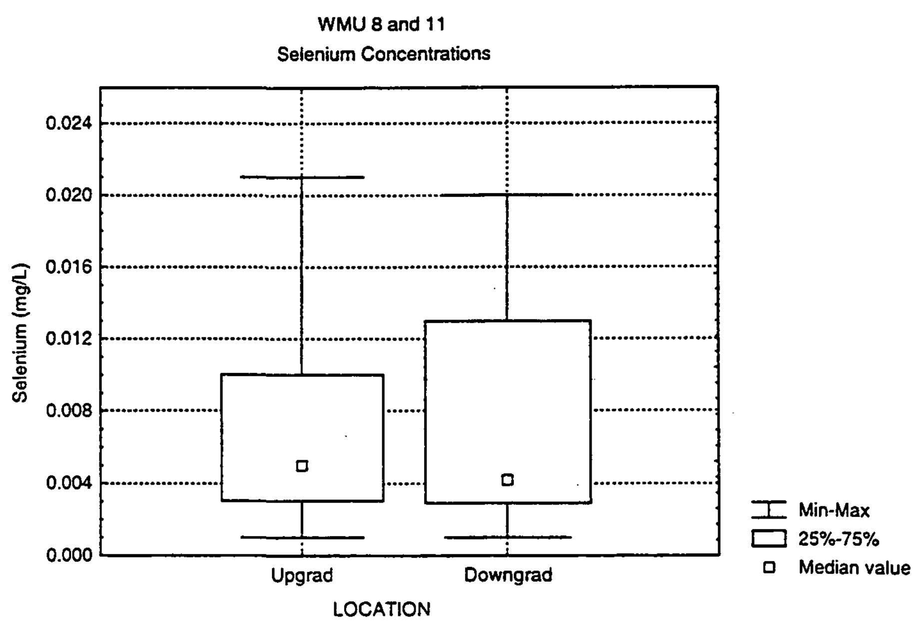


WMU 8 and 11 -- TEST 1 -- SELENIUM

STAT. NONPAR STATS	Mann-Whitney U Test (wmu8-se.sta) By variable LOCATION Group 1: 1-Upgrad Group 2: 2-Downgrad					
variable	Rank Sum Upgrad	Rank Sum Downgrad	U	Z	p-level	Z adjusted
SE_CONC	2766.500	4736.500	1731.500	-.005306	.995766	-.005321

STAT. NONPAR STATS	Mann-Whitney U Test (wmu8-se.sta) By variable LOCATION Group 1: 1-Upgrad Group 2: 2-Downgrad		
variable	p-level	Valid N Upgrad	Valid N Downgrad
SE_CONC	.995754	45	77

Summary: Downgradient and upgradient selenium concentrations are statistically the same.



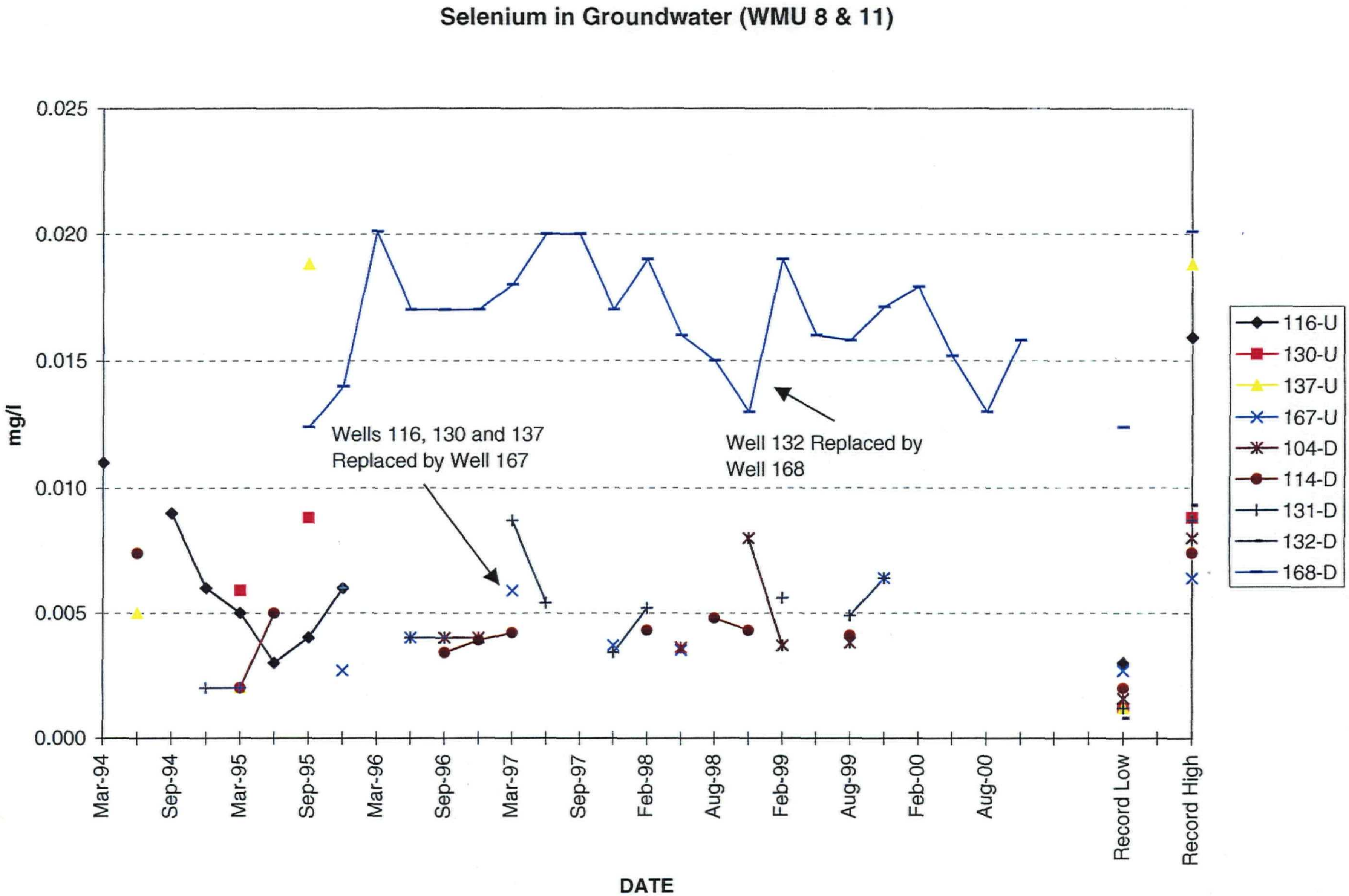
TEST 2
STATISTICS FOR PHASE IV PONDS & POND 8E (WMU 8 AND 11)

Selenium

	Upgradient Wells					Downgradient Wells			
Date	Well 116	Well 130	Well 137	Well 167	Well 104	Well 114	Well 131	Well 132	Well 168
Sep-91	**0.016**	**0.002**	**0.004**	N.S.	0.002	0.002	0.002	0.002	N.S.
Dec-91	**0.021**	**0.002**	**0.003**	N.S.	0.002	0.003	0.003	0.002	N.S.
Mar-92	**0.013**	**0.010**	**0.002**	N.S.	0.002	0.002	0.003	0.002	N.S.
Jun-92	**0.014**	**U**	**U**	N.S.	U	U	U	0.002	N.S.
Sep-92	**0.011**	**0.001**	**0.001**	N.S.	U	U	0.001	U	N.S.
Dec-92	**0.013**	**0.009**	**0.004**	N.S.	0.002	U	0.003	U	N.S.
Mar-93	**0.015**	**0.005**	**0.006**	N.S.	0.004	0.004	0.006	0.009	N.S.
Jun-93	**0.016**	**0.001**	**0.002**	N.S.	U	0.003	U	U	N.S.
Sep-93	**0.010**	**U**	**0.004**	N.S.	0.003	0.003	0.005	U	N.S.
Dec-93	**0.007**	**0.002**	**0.003**	N.S.	0.002	U	0.004	0.001	N.S.
Mar-94	**0.011**	**U**	**U**	N.S.	U	U	U	U	N.S.
Jun-94	**U**	**U**	**0.005**	N.S.	U	0.007	U	U	N.S.
Sep-94	**0.009**	**U**	**U**	N.S.	U	U	U	U	N.S.
Dec-94	**0.006**	**U**	**U**	N.S.	U	U	0.002	U	N.S.
Mar-95	**0.005**	**0.006**	**0.002**	N.S.	U	0.002	0.002	U	N.S.
Jun-95	**0.003**	**U**	**U**	N.S.	U	0.005	U	U	N.S.
Sep-95	**0.004**	**0.009**	**0.019**	**U**	U	U	U	U	0.012
Dec-95	**0.006**	**U**	**U**	**0.003**	U	U	0.006	N.S.	0.014
Mar-96	**N.S.**	**N.S.**	**N.S.**	**U**	U	U	U	N.S.	0.020
Jun-96	**N.S.**	**N.S.**	**N.S.**	**0.004**	U	U	0.004	N.S.	0.017
Sep-96	**N.S.**	**N.S.**	**N.S.**	**U**	0.004	0.003	0.004	N.S.	0.017
Dec-96	**N.S.**	**N.S.**	**N.S.**	**U**	0.004	0.004	U	N.S.	0.017
Mar-97	**N.S.**	**N.S.**	**N.S.**	**0.006**	U	0.004	0.009	N.S.	0.018
Jun-97	**N.S.**	**N.S.**	**N.S.**	**U**	U	U	0.005	N.S.	0.020
Sep-97	**N.S.**	**N.S.**	**N.S.**	**U**	U	U	U	N.S.	0.020
Dec-97	**N.S.**	**N.S.**	**N.S.**	**0.004**	U	U	0.003	N.S.	0.017
Feb-98	**N.S.**	**N.S.**	**N.S.**	**U**	U	0.0043	0.0052	N.S.	0.019
May-98	**N.S.**	**N.S.**	**N.S.**	**0.0035**	0.0036	U	U	N.S.	0.016
Aug-98	**N.S.**	**N.S.**	**N.S.**	**U**	U	0.0048	U	N.S.	0.015
Nov-98	**N.S.**	**N.S.**	**N.S.**	**U**	0.008	0.0043	U	N.S.	0.013
Feb-99	**N.S.**	**N.S.**	**N.S.**	**U**	0.0037	U	0.0056	N.S.	0.019
May-99	**N.S.**	**N.S.**	**N.S.**	**U**	U	U	U	N.S.	0.016
Aug-99	**N.S.**	**N.S.**	**N.S.**	**U**	0.0038	0.0041	0.0049	N.S.	0.0158
Nov-99	**N.S.**	**N.S.**	**N.S.**	**0.0064**	U	U	0.0064	N.S.	0.0171
Mar-00	***N.S.***	***N.S.***	***N.S.***	***U***	*U*	*U*	*U*	*N.S.*	*0.0179*
May-00	***N.S.***	***N.S.***	***N.S.***	***U***	*U*	*U*	*U*	*N.S.*	*0.0152*
Aug-00	***N.S.***	***N.S.***	***N.S.***	***U***	*U*	*U*	*U*	*N.S.*	*0.013*
Nov-00	***N.S.***	***N.S.***	***N.S.***	***U***	*U*	*U*	*U*	*N.S.*	*0.0158*

	Well 116	Well 130	Well 137	Well 167	Well 104	Well 114	Well 131	Well 132	Well 168
Pre-2000 Mean	**0.011**	**0.005**	**0.005**	**0.004**	0.003	0.004	0.004	0.003	0.017
2000 Mean	**#N/A**	**#N/A**	**#N/A**	**#N/A**	#N/A	#N/A	#N/A	#N/A	0.015
1991-2000 Summary									
Mean	**0.011**	**0.005**	**0.005**	**0.004**	0.003	0.004	0.004	0.003	0.017
Standard Error	**0.001**	**0.001**	**0.001**	**0.001**	0.000	0.000	0.000	0.001	0.000
Median	**0.011**	**0.003**	**0.004**	**0.004**	0.004	0.004	0.004	0.002	0.017
Mode	**0.016**	**0.002**	**0.004**	**#N/A**	0.002	0.002	0.002	0.002	0.017
Standard Deviation	**0.005**	**0.003**	**0.005**	**0.001**	0.002	0.001	0.002	0.003	0.002
Sample Variance	**0.000**	**0.000**	**0.000**	**0.000**	0.000	0.000	0.000	0.000	0.000
Kurtosis	**-0.558**	**-1.598**	**9.357**	**-1.506**	4.913	2.027	0.177	5.646	-0.513
Skewness	**0.260**	**0.539**	**2.932**	**0.782**	1.880	1.022	0.383	2.344	-0.256
Range	**0.018**	**0.009**	**0.018**	**0.003**	0.006	0.005	0.008	0.008	0.008
Minimum	**0.003**	**0.001**	**0.001**	**0.003**	0.002	0.002	0.001	0.001	0.012
Maximum	**0.021**	**0.010**	**0.019**	**0.006**	0.008	0.007	0.009	0.009	0.020
Sum	**0.180**	**0.046**	**0.055**	**0.027**	0.044	0.059	0.085	0.018	0.365
Count	**17**	**10**	**12**	**6**	13	16	20	6	22

U = Not Detected; #N/A = Value not calculated because of non-detect or not sampled values in data set.
N.S = Not Sampled, Upgradient well(s) in bold; 2000 data in italics.
All concentrations in mg/l.



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Appendix G

APPENDIX G

TASK-SPECIFIC HEALTH AND SAFETY PLAN FOR PHASE IV PONDS CLOSURE ACTIVITIES

Table of Contents

Task-Specific Health and Safety Plan for Phase IV Ponds Closure Activities

1. INTRODUCTION

This Health and Safety (H&S) Plan addresses the task-specific health and safety issues associated with the closure activities of the Phase IV ponds. This Plan is an appendix to the Closure Plan for the Phase IV ponds and is also a task-specific supplement to the Eastern Michaud Flats (EMF) Remedial Investigation/Feasibility Study (RI/FS) Health and Safety Plan (February 1992). The EMF RI/FS Health and Safety Plan has been developed based on 29 C.F.R. §1910.120, Hazardous Waste Operations and Emergency Response (HAZWOPER), and the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, NIOSH/OSHA/ USCG/EPA, October 1985, Pub. No. 85-115. The EMF RI/FS Health and Safety Plan is referenced for general health and safety policy and FMC safety requirements.

Although this plan is task-specific with regard to the planned closure activities, some flexibility has been built in to cover unforeseen conditions that may arise. All personnel involved in these activities are required to follow this task-specific H&S Plan. FMC' Safety Plan and site-wide emergency plan will also apply and must be followed during the entire Phase IV Ponds closure activities.

FMC' Contractor Safety Requirements are provided as Attachment G-1 to this appendix.

2. SCOPE OF WORK

The Phase IV ponds closure activities include pumping the waste water out of the pond as it is being backfilled with initial fill of sand and slag. Once backfill operations are completed, a subgrade will be placed over the backfill and a RCRA closure cap will be placed over the subgrade.

The Phase IV ponds closure activities will involve soil- and sediment-intrusive activities that may disturb or unearth buried "pockets" of phosphine gas (PH_3), elemental phosphorus (P_4) or sediments containing elemental phosphorus. In the presence of air, elemental phosphorus oxidizes creating a fire and potential burns hazard as well as giving off phosphorus pentoxide (P_2O_5). Phosphine gas (PH3) may also be evolved as a result of reactions of phosphorus in aqueous solution. To minimize the potential exposure to the hazards of elemental phosphorus and associated compounds, special safety precautions will be taken, personal protective equipment/clothing will be used, and good personal hygiene practices will be required. Specific work elements associated with the Phase IV ponds work will include:

- Contractor mobilization
- Position geotextile; then add sand and pump out water.
- Place sand backfill and geogrid material in the ponds as needed to provide a working platform over the entire pond surface.
- Install a wick drain system to accelerate consolidation of the pond sludge.
- Place slag backfill to load the pond sludge, rough grade and install settlement monitoring plates on the subgrade.
- Install temporary geomembrane with bedding material over the slag fill to prevent water infiltration to pond area during pond sludge consolidation period.
- Demobilize the Contractor. Monitor subgrade settlement until settlement rate has diminished to an acceptable level.

3. HAZARD ASSESSMENT

3.1 Chemical Hazards

The primary constituents of concern during the Phase IV ponds closure process are elemental phosphorus, phosphorus pentoxide, and phosphine gas. Other possible constituents are heavy metals. These chemicals can enter the body via inhalation, ingestion, or absorption through the skin. Some chemicals can enter the body by more than one route and may cause damage at the site of contact or at target organs throughout the body.

3.1.1 Elemental Phosphorus (P_4) and Phosphorus Pentoxide (P_2O_5)

Elemental phosphorus is considered a poison, which exhibits acute and chronic toxicity if inhaled or ingested. Dermal contact, especially skin, eye, and other mucous membrane exposure to elemental phosphorus must be avoided because of its ability to burn human tissues.

Symptoms of acute exposure due to external skin or membrane contact include burning and irritation of skin, eyes, and mucous membranes. Symptoms of acute poisoning due to ingestion include sweating, nausea and vomiting, diarrhea, and cyanosis. Symptoms of acute poisoning due to inhalation can include respiratory tract irritation, photophobia with mycosis, pupil dilation, as well as retinal hemorrhage and other associated visual disorders.

Symptoms of chronic inhalation or ingestion of elemental phosphorus include general weakness, anemia, gastrointestinal effects, and skeletal system degeneration evidenced as brittleness of the long bones (especially a condition known as "phossy jaw" or necrosis of the jawbone). Any employees with dental work that opens pathways to the jaw, such as tooth extractions within the past 30 days, will not be allowed to work on the site.

Oxidation of elemental phosphorus produces phosphorus pentoxide (P_2O_5) aerosols that may be encountered during dewatering, grading, and excavation activities in the work zone. Phosphorus pentoxide reacts with water in the air and on mucous membrane surfaces of the eyes, nose, throat, or lungs to form phosphoric acid, which can irritate these mucous membranes. Appropriate respirators will be worn in exclusion zone areas, in accordance with Section 5 of this H&S Plan, any time that personnel encounter visible amounts of P_2O_5 (usually visible as a white "smoke"), or any time that workers exhibit any symptoms of exposure, including scratchy throat, coughing or sneezing, or other evidence of irritated mucous membranes.

Care will be taken to control dust evolution during any activity that could potentially disturb exposed pond sediments.

Permissible exposure limits, routes of entry, irritant classification, and potential effects from exposure to these two compounds are indicated in Table G-1. In addition to using work practices that minimize exposure potential, personal protective equipment/clothing will be used as indicated and use of good personal hygiene practices will be enforced. Attachment G-2 contains a copy of FMC' Phosphorus Minimum Mandatory Standards.

3.1.2 Phosphine Gas (PH_3)

Phosphine is a colorless gas with a foul odor of decaying fish. High concentrations can be pyrophoric (oxidizing to P_2O_5 in the presence of atmospheric oxygen). Lower concentrations can be toxic by inhalation. Acute poisoning by inhalation of high concentrations can cause convulsions and coma, leading to death within 48 hours. Acute toxic effects due to inhalation at lower concentrations are central nervous system depression, lung irritation leading to pulmonary edema, dilation of the heart, and hyperemia of the visceral organs.

Chronic poisoning, characterized by anemia, bronchitis, gastro-intestinal disturbances, and visual, speech, and motor disturbances, may result from continued exposure to low concentrations. Work area and worker breathing zone phosphine levels will be carefully monitored. At levels approaching the permissible exposure limit (PEL), the job may be temporarily closed to allow dissipation, or Level B respiratory protection will be used.

3.1.3 Heavy Metals

Cadmium, chromium, arsenic, and other heavy metals may be encountered in soils and waste streams during closure activities. Inhalation, dermal contact, and ingestion are potential routes of exposure with these metals. Permissible exposure limits, routes of entry, irritant classification, and potential effects from exposure to these metals are indicated in Table G-1. To minimize the potential for exposure, an aggressive dust control program will be enforced, personal protective equipment/clothing will be used in accordance with this H&S Plan, and use of good personal hygiene practices will be required of all site personnel.

TABLE G-1
POTENTIAL EFFECTS OF CHEMICALS THAT MAY BE PRESENT AT THE PHASE IV PONDS SITE

CHEMICAL	PEL[a]	ROUTE OF ENTRY[b]	IRRITANT	POTENTIAL EFFECTS: ACUTE	POTENTIAL EFFECTS: CHRONIC
Inorganic Arsenic and compounds (as As)	0.01 mg/m^3 0.002 mg/m^3 NIOSH[c]	INH, ING, C	Medium	Headache, nausea, skin irritation	Skin pallor, exacerbation of acute symptoms
Cadmium (dust)	0.005 mg/m^3	INH, C	Medium	Headache, cough, tightness of chest, nausea, diarrhea, muscle aches	Pulmonary edema, mild anemia, emphysema
Chromium insoluble (as Cr VI)	0.05 mg/m^3 [d]	INH, ING, C	Medium		Histologic fibrosis of lungs, Cr (VI) carcinogen (H_20 insol.)
Fluorides	2.5 mg/m^3	INH, ING, C	High	Irritation of eyes and resp. system, nausea, abdominal pain, excess salivation	Stiff spine, calcification of ligaments of ribs, pelvis
Hydrogen Cyanide	4.7 ppm [f]	INH, ING, Skin	Moderate	Weakness, headache, confusion, vertigo, fatigue, anxiety, dermatitis, dyspnea, nausea, and vomiting, unconsciousness, convulsions, death	Same as acute plus itching, scarlet rash, thyroid changes, Frank Goiter, conjunctivitis, super keratitis
Nickel and compounds (soluble)	0.10 mg/m^3	INH, ING, C	Medium	Allergic asthma, irritates nasal cavity	Sensitization dermatitis, pneumonitis, cancer
Nuisance Dust Total Respirable	 15 mg/m^3 5 mg/m^3	 INH INH	 Low Low	Irritation of respiratory tract	Pneumoconiosis
Phosphine gas (PH_3)	0.3 ppm TWA 1 ppm [e]	INH	High	Nausea, vomiting, abdominal pain, diarrhea, chest pressure, muscle pain	Anemia, bronchitis, gastrointestinal disturbances
Phosphoric acid	1 mg/m^3 TWA 3 $mg/m^{3(e)}$	INH, ING, C	High	Irritation of upper respiratory tract and eyes; burns skin	Dermatitis

TABLE G-1 (continued)
POTENTIAL EFFECTS OF CHEMICALS THAT MAY BE PRESENT AT THE PHASE IV PONDS SITE

CHEMICAL	PEL(a)	ROUTE OF ENTRY(b)	IRRITANT	POTENTIAL EFFECTS	
				ACUTE	CHRONIC
Phosphorus - elemental (P_4)	0.1 mg/m^3	INH, ING, C	High	Irritation of eyes and respiratory tract, burns skin and eyes, abdominal pain, dental and jaw pain, excess salivation, nausea, jaundice	General Debilitation
Phosphorus pentoxide (P_2O_5)	Not published (ALARA) (g)	INH, C	Medium	Irritation of eyes, mucous membranes, skin	Stomach hemorrhages, calcium metabolism disturbance
Silica (amorphous)h	1.5 mg/m^3	INH	Medium	Irritation of eyes, respiratory tract	Pneumoconiosis
Silica (crystalline quartz - Total) h	0.6 mg/m^3	INH	Medium	Irritation of eyes, respiratory tact	Silicosis
Silica (crystalline quartz - Respirable) h	0.2 mg/m^3	INH	Medium	Irritation of eyes, respiratory tract	Silicosis

Notes: (a) Permissible exposure limit (PEL) — OSHA 8-hour time-weighted average.
(b) Inhalation = INH; Ingestion = ING; Dermal contact = C
(c) NIOSH recommended exposure limit.
(d) American Conference of Governmental Industrial Hygienists (ACGIH).
(e) Short-term exposure limit (STEL).
(f) Eight-hour time-weighted average.
(g) As Low As Reasonably Achievable.
(h) Based on a silica (SiO_2) content of 50%.

3.2 Biological Hazards

The main biological hazards of concern at the FMC facility are rattlesnakes, bees and wasps, black widow spiders, and ticks. In most cases, these hazards will be encountered only in site areas where tall brush, rocks, and debris are present. Such encounters are likely to be minimal near the Phase IV ponds. Personnel with known allergic reactions to insect stings will be identified and supervisors made aware of this accordingly.

3.3 Physical Hazards

Physical hazards associated with the Phase IV ponds closure activities are those associated with excavation, processing, and transport of backfill materials; heavy equipment operation and handling; equipment cleaning activities; high noise levels; slipping, tripping, and falling hazards; temperature extremes that can cause sunburn and heat stress, frost bite and hypothermia; utilities (overhead and underground); fire and smoke hazards; and traffic inside the FMC plant. Incidents can be avoided with proper safety measures, common sense, and attention to the task being performed and to the conditions present in the work place, and by following current plant safety policies and practices for those hazards and the requirements set forth in this task-specific H&S Plan.

The subcontractor will provide a site-specific Job Hazard Analysis, Emergency Rescue Plan and Standard Operating Procedures (SOPs) for each assigned task related to the Phase IV ponds closure activities. All personnel will be properly trained in the safe performance of their duties, and familiarization with SOPs for each assigned task will be an important component of that training. Records of all training shall be maintained with general site safety documentation.

3.3.1 Heavy Equipment/Equipment Cleaning Activities

In all cases, rotating shafts or gears on heavy equipment should be covered or guarded to prevent accidental contact. Only experienced/qualified operators will be allowed to operate and work around this equipment. Special precautions will be observed during all heavy equipment operation to avoid potential accidents due to equipment operation (i.e., use of operator seat belts, properly operating safety devices such as back-up alarms, no loose fitting clothing, etc.). Work zone delineation as per 29 C.F.R. §1910.120 (i.e., an Exclusion Zone and Contamination Reduction Zone) will be maintained around the Phase IV ponds during closure activities, as discussed in Section 7 of the H&S Plan.

No ground personnel will be permitted within the operating radius of any heavy equipment unless absolutely necessary. In the event that use of a spotter is required, that individual alone will be allowed within the operating radius of the equipment and shall use a prearranged series of hand signals, maintaining eye contact with the operator at all times. No individual shall approach operating equipment without first making eye contact with the operator and clearly signaling the intent to approach. Ground personnel in the work zones shall wear high visibility vests.

A truck or trailer-mounted engine or generator may be used to operate a high-pressure steam cleaner to decontaminate heavy equipment during work activities. The hazards associated with steam cleaning are electric shock and electrical and thermal burns.

3.3.2 Noise

Personnel who are exposed to noise levels greater than 85 dBA in the work zone will be required to wear hearing protection subject to a compliant Hearing Conservation Program. All personnel operating or working in the immediate vicinity of heavy equipment will be required to use approved hearing protection. Training and hearing protection, as required by 29 C.F.R. §1910.95, shall be provided to all affected personnel.

3.3.3 Slipping, Tripping, and Falling Hazards

The Phase IV ponds closure area may contain various hazards that can cause slipping, tripping, and falling. Some of these include tools, cleaning equipment, cables, and ropes, and so on. Some areas where slipping hazards could occur are wet surfaces in the work area, equipment decontamination area, and personnel decontamination area. To minimize these risks, housekeeping will be given utmost priority. If snow, rain, or ice become a hazard, work will be stopped until the area has been properly shoveled, drained, or has sufficiently dried to allow work to continue without endangering the workers. Personnel will be provided with full body safety harnesses and lanyards (fall protection) to be used for all work activities performed at a height greater than six feet above ground on unprotected work surfaces/platforms per 29 C.F.R. §1926.104.

3.3.4 Temperature Extremes

Heat stress may be a hazard during hot weather and is intensified when workers are required to wear protective clothing. Workers will be required to take breaks as needed, and will be encouraged to consume adequate quantities of liquid. Potable drinking water will be available in a designated break area located immediately outside the contamination reduction zone. Workers will be briefed on the symptoms of heat-related problems such as heat rash, heat cramps, heat exhaustion, and heat stroke. All workers are responsible for self-monitoring as well as for looking out for their coworkers when heat stress conditions occur. The Site Health and Safety Officer (SHSO) will be immediately notified of all heat-stress-related conditions and will institute work rest regimes as conditions dictate.

The SHSO has the authority to suspend work when low temperatures (with consideration of the wind chill factor) occur, or snow or rain is falling and work place conditions become hazardous to personnel. Each worker is responsible for self-monitoring as well as looking out for his/her coworkers, particularly during adverse conditions. The SHSO will be immediately notified of hypothermia and/or cold- or wet-weather-related safety conditions.

Work-rest regimens during all periods of temperature extremes will follow guidelines established by the American Conference of Governmental Industrial Hygienists (ACGIH).

3.3.5 Utilities

If pond closure work is in close proximity to overhead, surface, and underground utilities, management and work crew personnel will exercise every precaution and safe practice to ensure avoidance of these utility lines (i.e., pipelines, electrical conduit, and wires). Measures will include:

- A complete review of engineering or physical plant plans associated with travel routes to/and from work locations
- Use of appropriate underground utility detection equipment as necessary
- Confirmation of information with appropriate FMC facilities personnel
- No operation of crane or boom equipment within 25 feet of any energized overhead power lines

All management and work crew personnel will be briefed as to the location of all utilities.

Pond sediment- or soil-intrusive, subsurface, or otherwise pond sediment- or soil-disturbing work, and any below-grade work will only be conducted under a current and approved Hazardous Work Permit (HWP)/Confined Space Entry Permit and under the direct supervision of the appropriate FMC Project Manager. For hazardous work, appropriate sections of the form will be filled out by the appropriate FMC work supervisor, but must be approved and signed by the SHSO as well as the appropriate FMC project management personnel. The completed permit form will be clearly posted at each work location.

The movement and stationing of heavy equipment, as well as the staging locations and movement of all cranes, will be carefully planned and coordinated with the appropriate FMC project management and facilities personnel. HWPs will be obtained from FMC project management prior to equipment moving on site and before beginning any sediment- or soil-intrusive work.

If any below-grade work is necessary, the entire HWP/Confined Space Entry Permit must be completed. A copy of the combined HWP/Confined Space Entry Permit is provided in Figure G-1.

3.3.6 Fire and Smoke Hazards

Fire and smoke are serious hazards posed by the presence of elemental phosphorus. Any fire and smoke should be dealt with immediately before work is continued. Elemental phosphorus burns (oxidizes) when supplied with oxygen, as previously discussed in the Chemical Hazards section. Phosphorus pentoxide can also react with water to produce phosphoric acid as previously discussed in the Chemical Hazards section. The waste material in the Phase IV ponds has not been dried and it is likely that elemental phosphorus will be encountered during the filling procedures. Also, pockets of elemental phosphorus may be encountered during the course of intrusive activities exposing work crew personnel to elemental phosphorus and its associated hazards.

If fire and/or smoke is observed during Phase IV pond closure work or while excavating, work will immediately be stopped and water applied to any exposed waste material or contaminated equipment. The material will be stockpiled and covered with sand, soil or slag. Disposition of the material will be directed by FMC. All work activities must comply with the safety requirements specified in the FMC Contractor Safety Requirements (Attachment G-1):

- General Plant Safety Rules
- Respiratory Protection
- Confined Space
- Lock-out/Tag-out
- Barricades
- Fall Protection
- Safe Use of Scaffolding
- Entering Trenches & Excavations

4301

ATTACHMENT #1 revised 1/95

Fill in 1 to 10 for **HAZARDOUS WORK** ____ Fill in All for **CONFINED SPACE PERMIT** ____

AUTHORIZED DURATION: Date: ________ to ________ Time: ________ to ________

1. LOCATION AND NAME OR NUMBER OF UNIT ________

2. PURPOSE OF WORK ________

3. ELECTRICAL ISOLATION
Have electrical breakers been locked and tagged out? Yes ______ No ______ Not Applicable ______
List Breakers locked and tagged out: ________

4. VALVE ISOLATION
Inlet Valves: Blocked ______ Blanked ______ Locked/Tagged ______ Not Applicable ______
Outlet Valves. Blocked ______ Blanked ______ Locked/Tagged ______ Not Applicable ______

5. Has unit been cleaned or purged? Yes ____ No ____ Not Applicable ______
List how unit was cleaned or purged and by whom ________

6. Is a special safety procedure involved in this job? Yes ____ No ____ Not Applicable ____
If yes, what is the procedure? ________

7. CHECK SAFETY EQUIPEMENT NECESSARY:

	Yes	No		Yes	No		Yes	No
a. Safety Hat			h. Rubber Boots			o. Fresh Air Mask		
b. Safety Glasses			i. Rubber Pants			p. Emergency Breathing		
c. Face Shield			j. Aluminum Coat			q. Safety Harness		
d. Welding Shield			k. Aluminum Pants			r. Warning Signs		
e. Coveralls			l. Dust Respirator			s. Barricades		
f. Gloves			m. Chemical Respirator			t. Fire Extinguisher		
g. Rubber Gloves			n. Charged Water Hose			u. Other (list)		

8. SAFETY REMARKS ________

9. Will a safety observer/attendant be standing by?
Yes ____ No ____

10. HAZARDOUS WORK PERMIT:
Supervisor Sig ________ Employee Sig ________

11. PERMIT SPACE HAZARDS (indicate specific hazards with initials)
____ Oxygen deficiency (less than 19.5%)
____ Oxygen enrichment (greater than 23.5%)
____ Flammable gases or vapors (greater than 10% of LFL)
____ Airborne combustible dust (meets or exceeds LFL)
____ Toxic gases or vapors (greater than PEL)
____ Mechanical hazards
____ Electrical Shock
____ Materials harmful to skin
____ Engulfment
____ Other: ________

12. PREPARATION FOR ENTRY
____ Notification of affected departments of service interruption
____ Personnel Awareness:
____ Pre-entry briefing on specific hazards and control methods
____ Notify contractors of permit and hazard conditions
____ Other: ________

13. EQUIPMENT REQUIRED FOR ENTRY AND WORK
Specify as Required:
Atmospheric Testing/Monitoring ________
Communication: ________
Rescue Equipment: ________
Other: ________

14. COMMUNICATION PROCEDURES
To be used by attendants and entrants:
RADIO ________
TELEPHONE ________
OTHER ________

15. EMERGENCY SERVICE
Merg / Fire Brigade ______ Phone Number 66__
Merg / Fire Brigade ______ Chanel 2 on Radio ; Contact Gate House ask for Merg or Fire Brigade
Outside Emergency Services are available through the Gate House. Incident Command System Will determine if needed.

16. TESTING RECORD — 4 Gas analyzer ID # ________

Time ______	Acceptable Conditions	Result TOP	Result MIDDLE	Result BOTTOM
Oxygen-min	> 19.5% <23.5%			
H2S	< 10ppm			
Flammability	< 10% LEL/LFL			
PH3	< 0.3 ppm			
Toxic (specify)				
CO	< 35ppm			
SO2	< 2ppm			
Heat	F/C			
Other				
Test Intervals	Shift Beg. ____ End ____	Every ______ Hours		
Tester Initials				

Planning Meeting Attendance ________

17. APPROVAL SIGNATURES
* IF ALL PLANT SAFETY RULES ARE NOT BEING FOLLOWED, A MEMBER OF THE SAFETY DEPARTMENT MUST REVIEW AND APPROVE THIS PERMIT.

Operator/Attendant/Observer ________
Unit Manager / Delegate/ Entry Supervisor ________
Maintenance Forman / Delegate ________
* Safety Department Representative ________

DISTRIBUTION White - Safety Office Pink - Operating Supervisor Blue - Maintenance Supervisor

Figure G-1
Hazardous Work Permit/Confined Spaces Entry Permit

- Hair, Beards, and Mustaches
- Minimum Dress Standards
- Substance Abuse Policy Guidelines

Fire protection and prevention with respect to use and storage of flammable or combustible materials, fuel, or other substances will be in accordance with OSHA handling and storage requirements and special procedures set forth by the manufacturer, as shown on the Material Safety Data Sheet (MSDS). It is not anticipated however, that any flammable materials and/or fuel will be stored at the closure area.

Personnel will immediately report all fires to FMC Security (Gatehouse) by calling 55 on the plant telephone system, (208) 236-8236 on a non-plant telephone, or over the field radio, regardless of size or damages incurred to the area where the fire occurred.

All heavy equipment, cranes, site vehicles, and all other internal-combustion-powered equipment will be equipped with a carbon dioxide or dry chemical ABC-rated fire extinguisher. These fire extinguishers will be used only on equipment fires of a nonphosphorus origin (i.e., only on electrical; mechanical; related fires such as grease, oil, gasoline; or other combustible material).

3.3.7 Traffic

All FMC traffic rules will be strictly enforced. Where congestion or existing plant traffic patterns demand, FMC will provide all equipment and personnel (cones, warning signs, reflective safety vests, barricade tape, flagging, flaggers, etc.) to conduct the work safely.

FMC facility speed limits will be observed and right-of-way will be given in all cases to emergency vehicles, haul vehicles, and cranes.

3.4 Hazard Assessment Summary

Given the hazards or hazardous situations noted above, it appears that any situation can be adequately controlled. Educating workers about potential hazards, use of protective equipment, and limiting access to the area will minimize physical hazards. Chemical hazards can be reduced or controlled by close supervision and education of workers about site hazards, use of protective equipment supplemented with air monitoring, and implementation of safe work practices. Site-specific hazard assessments will be included in Site Health and Safety Orientation prior to employees commencing work on the site.

4. AIRBORNE DUST AND CONTAMINANTS

Heavy equipment operation activities during the closure of the Phase IV ponds have the potential of generating airborne fugitive dust. To mitigate the potential adverse effects to local air quality during closure activities, the following measures will be taken:

- Fugitive dust will be controlled by applications of water spray sufficient to suppress dust. When air monitoring results support the need, and PHOSPHINE IS NOT DETECTED at levels requiring respiratory protection, NIOSH/DHHS-approved (non-powered) air-purifying respirators equipped with a P100 (certified under 42 C.F.R. Part 84 as providing 99.97% particulate capture efficiency) filter cartridge will be worn as directed by the SHSO.

- Elemental phosphorus fires or P_2O_5 aerosols encountered during work will be controlled, to the extent feasible, by saturating the area with water, then covering the surface area with slag and/or sand. Air purifying respiratory protection against P_2O_5 shall include an acid gas component in combination with the P100 particulate filter element. A prefilter may be used if the brand of respirator selected provides such an option.

5. PERSONAL PROTECTIVE EQUIPMENT

5.1 Levels of Protection

Modified Level D, Level C (when phosphine is not present at levels requiring respiratory protection), and Level B personal protective equipment (PPE) will be the designated protective ensembles required for use during closure activities at the Phase IV ponds. Level C respiratory protection may also be required during certain operating plant emergencies.

At the FMC facility, all personnel must be clean-shaven and use air-purifying respirators in production areas as specified in the FMC Respirator Policy (reference Attachment G-1). When any soil-intrusive or wet work is performed within the established Exclusion Zone, aluminized two-piece Gantex suits (silver suits) will be worn (in addition to the PPE listed below) by all work location personnel. Silver suits must be worn with hard hats equipped with polycarbonate face shields and all-leather gauntlet gloves and all-leather or rubber steel-toed boots. Leather gauntlet gloves will be loose fitting to allow "throwing" the glove off in an emergency.

Unless air monitoring results dictate otherwise, work undertaken within the confines of the Phase IV ponds will be performed in Modified Level D PPE as outlined in this H&S Plan. Should site activities result in evolution of toxic gases and aerosols or dusts, upgrade to Level C or Level B PPE, as appropriate, will be required for all personnel within the immediate backfill (Exclusion Zone) work area.

Levels of protection are listed in the following subsections.

5.1.1 Level D PPE

Modified Level D PPE will be required for all personnel in the contamination reduction zone and will include:

- Gantex suit (for suspected or known elemental phosphorus areas).
- Splash shield (for suspected or known elemental phosphorus areas).
- Coveralls (Tyvek™, cloth, or equivalent) or long-sleeved shirt and full-length pants.
- Long leather gauntlet gloves.
- Chemical-resistant gloves (for specific tasks designated by the SHSO).
- Rubber steel-toed boots (or overboots over leather work boots).
- Hard hats.
- Hearing protection as required.
- Safety glasses with side shields or chemical splash goggles.
- High visibility vests as necessary.

5.1.2 Level C PPE

Level C PPE may be required within the Phase IV ponds Exclusion Zone as described above and will include (only for contaminants other than phosphine and only when phosphine levels do not require respiratory protection):

- NIOSH/DHHS-approved full or half-face air purifying respirators equipped with acid gas/P100 combination cartridges.
- Gantex suit (for suspected or known elemental phosphorus areas).

- Splash shield (for suspected or known elemental phosphorus areas).
- Coveralls (Tyvek™, cloth, or equivalent) or long-sleeved shirt and full-length pants.
- Long leather gauntlet gloves.
- Chemical-resistant gloves (for specific tasks designated by the SHSO).
- Rubber steel-toed boots (or overboots over leather work boots).
- Hard hats.
- Hearing protection as required.
- Safety glasses with side shields or chemical splash goggles.
- High visibility vests as necessary.

5.1.3 Level B PPE

Level B PPE may be required within the Phase IV ponds Exclusion Zone as described above and will include:

- NIOSH/MSHA-approved full-face positive pressure-demand self-contained breathing apparatus (SCBA) or full face positive pressure-demand air line supplied respirator with integrated 5-minute emergency egress bottle.
- Gantex suit (for suspected or known elemental phosphorus areas).
- Splash shield (for suspected or known elemental phosphorus areas).
- Coveralls (Tyvek™, cloth, or equivalent) or long-sleeved shirt and full-length pants.
- Long leather gauntlet gloves.
- Chemical-resistant gloves (for specific tasks designated by the SHSO).
- Rubber steel-toed boots (or overboots over leather work boots).
- Hard hats.
- Hearing protection as required.
- High visibility vests as necessary.

5.2 Phosphorus Minimum Mandatory Standards (PPE)

Phosphorus minimum mandatory standards for PPE are as follows:

- Standard aluminized short coat and pants (or aluminized bib overalls and coat).
- Safety hard hat (hood optional).
- Polycarbonate full-face shield (hood optional).
- Safety glasses.
- Loose fitting gauntlet-type gloves. They should be loose fitting so they can be slung off. No short, wrist-length gloves permitted.
- Rubber or leather steel-toed boots extending above the ankle. The objective is to prevent phosphorus from entering the boot.

PPE can reduce the possibility of contact with hazardous materials, but should also be used in conjunction with proper site entry protocol, proper SOPs, and other safety considerations. The use of PPE can create other significant health hazards such as heat stress, reduced mobility, psychological stress, vision impairment, and communication and hearing difficulties. Overprotection as well as underprotection can be hazardous and should be avoided.

In general, modified Level D Protection will be worn in the Support, Contamination Reduction, and Exclusion Zones unless unexpected contaminant concentrations are encountered. Level B PPE may be required for work undertaken in or entry into the immediate work area in the Exclusion Zone in the event that sustained contaminant concentrations in excess of FMC action levels are encountered. Subcontractors will provide all required PPE for their personnel. Contact lenses will not be allowed in work areas. Splash shields shall be used when there is a potential for encountering elemental phosphorus or for any splash hazards.

No changes to the specified levels of protection will be made without the approval of the SHSO.

5.3 Work Around Ponds

Because of the transient nature of phosphine and the measurements that have been recorded around the ponds, on December 19, 1997, FMC issued a special Safety Bulletin requiring the use of the following procedure while performing work around the ponds. The following procedure will apply to all work at the Phase IV Ponds and takes precedence if a conflict occurs:

- Up to 0.3 ppm; employees can work in the Phase IV Pond area for 8 hours without any protective devices.
- Above 0.3 ppm but less than 0.5 ppm; employees can work in the Phase IV Pond area for no longer than 5 hours without any protective devices. This stay time is based on the transient nature of phosphine and the continuous fluctuation levels that have been noted.
- Any time the concentration rises above 0.5 ppm for more than one minute or reaches 1.0 ppm for any time, employees are to evacuate the area and/or don supplied air respirators if work is to continue. Employees exposed twice to levels of 1.0 ppm or more for one minute cannot receive anymore phosphine exposure during that scheduled shift.
- Phosphine concentrations will be measured with a direct reading monitor at all times which will be in the possession of employees prior to entering the pond area.
- A radio will be carried at all times when working in the Phase IV Pond area.
- Employees must check in with the Pond Security Guard at the Pond 8S trailer (pond operators building).

6. SAFETY EQUIPMENT

The SHSO will have the following items available for immediate use at the Contamination Reduction Zone personnel decontamination station:

- 10-unit first aid kit (minimum).
- Supply of clean potable water and single-use disposable drinking cups.
- Disposable trash bags for nonhazardous waste.
- Waterless hand cleaner towelettes.
- Paper towels.
- Boot wash tubs (x2).
- Boot clean rinse tub (x1).
- Brushes with stiff bristles (x2).
- Nonphosphate containing detergent for wash tubs.
- Fire extinguisher (ABC Dry Chemical, 10 lb).

- Standby emergency water system charged and usable (a pressurized water hose).
- Safety tub water trough (for immersion of personnel).
- Wading pool (for spraying/decontaminating personnel leaving the Exclusion Zone).
- Portable eyewash (capable of delivering a continuous dual stream of water for 15 minutes).
- FMC portable radio (set to same channel as FMC Emergency Services and Guards).
- 55-gallon drums for disposing of contaminated wastes (such as PPE, etc.).
- Sanitary rest room facilities.

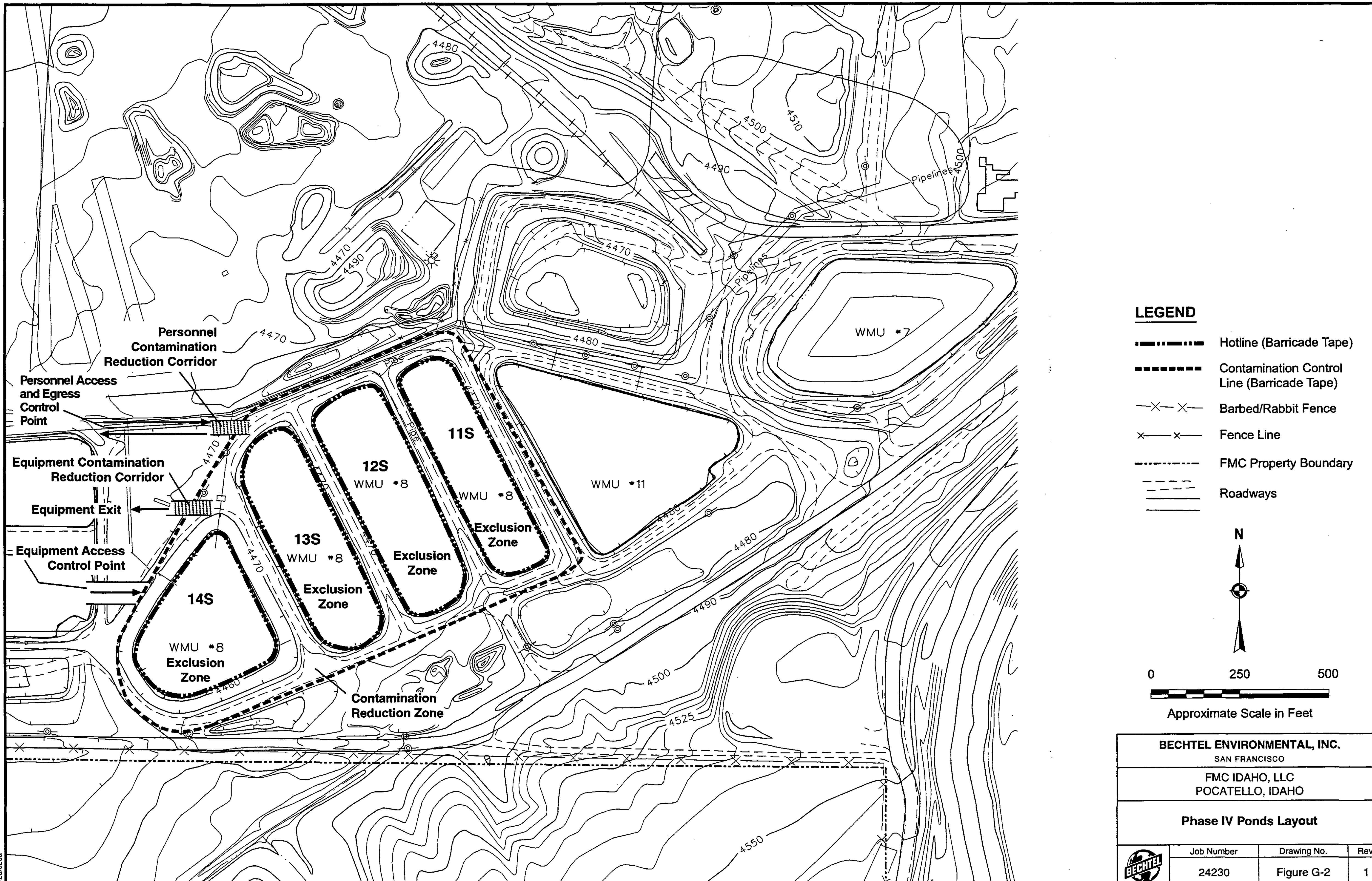
The SHSO will have the following additional items available for immediate use at the Exclusion Zone emergency personnel decontamination station:

- Emergency immersion trough.
- Emergency drench (water truck or other suitable high-volume water source).
- Air horn.

7. WORK ZONES

Work zones will be established per 29 C.F.R. §1910.120 to minimize the possibility of worker exposure to hazardous contaminants and to control the dispersal of contaminants to adjacent support zone "clean areas". The exact boundaries of the work zones will be determined by the SHSO upon mobilization to the site based upon site conditions including site access, contaminant location and concentrations, prevailing wind conditions, and preliminary air monitoring results (reference Figure G-2). Closure activities will be conducted within the following three zones: Exclusion Zone (EZ), Contamination Reduction Zone (CRZ), and Support Zone (SZ). The use of the "buddy system" will be employed for all personnel entering the CRZ and EZ.

Figure G-2 indicates the proposed layouts of the EZ, CRZ, and SZ for the Phase IV ponds closure area.



BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC IDAHO, LLC POCATELLO, IDAHO		
Phase IV Ponds Layout		
Job Number	Drawing No.	Rev.
24230	Figure G-2	1

SFOSB092\BS_EMF_DRAWROOT\BEI_DESIGN2_FMC\PhaseIV\P4_layout.ai
04/26/02da

7.1 Exclusion Zone (EZ)

The EZ is the area where contaminated material is encountered and handled. For the Phase IV ponds closure activities, it will be defined as the area of exposed pond substrate and the fill area immediately adjacent. The outer boundary of the EZ is called the HOTLINE. This boundary separates the EZ from the CRZ and will be clearly marked by visible yellow barricade tape (i.e., CAUTION DO NOT ENTER), visible lines, placards or signs, or enclosed by physical barriers such as chains, ropes, or fences. Routine access is limited to the Contamination Reduction Corridor in order to regulate the flow of personnel and equipment into and out of the EZ and to help make sure that the proper procedures for entering and exiting are followed.

7.2 Contamination Reduction Zone (CRZ)

The CRZ is established to provide an area in which to remove any contaminants that may have been picked up by personnel or equipment in the EZ. All routine personnel decontamination activities will take place in the CRZ. Emergency preliminary personnel decontamination will take place at an emergency station established within the EZ at the active work site itself. Gross equipment decontamination will also take place within the confines of the work zone, with final decontamination to be performed at a dedicated equipment decontamination facility at the periphery of the EZ.

The boundary between the SZ and the CRZ is the Contamination Control Line. This boundary separates the possibly contaminated areas from the clean zone. Entry into the CRZ from the clean zone is through a single access control point.

At the boundary between the CRZ and EZ is the HOTLINE and an access control station. Personal protective equipment as outlined previously, is required for all personnel entering the EZ regardless of type or duration of planned activity. Separate personnel and equipment decontamination stations will be established adjacent to the HOTLINE. Any potentially contaminated clothing or equipment must remain in the CRZ until decontaminated.

7.3 Support Zone (SZ)

The SZ (clean zone) will include areas not defined as CRZ, EZ, or general work zones. Job site administrative services, bulk supply storage, lay down area, and vehicle parking will be located in this zone. Any potentially contaminated clothing must remain in the CRZ until decontaminated.

Support Zone personnel are responsible for alerting proper authority in the event of an emergency. All telephone numbers, evacuation route maps, communications equipment, and vehicle keys should be kept in the SZ.

7.4 Work Zone Summary

All of the Phase IV ponds closure activities will be conducted within the EZ and CRZ utilizing the "buddy system" (i.e., no less than two persons at all times in the EZ or CRZ).

The Phase IV ponds EZ must be large enough to allow room to maneuver the heavy equipment and maintain an emergency decontamination station without restricting personnel movement in the EZ. A HOTLINE barricade tape will be placed around the EZ (using traffic cones or T-posts to secure the tape and outline the EZ). A CRZ Contamination Control Line barricade tape will be placed around the EZ HOTLINE a minimum of 3 feet away and will include the personnel and equipment decontamination pads/access control points for accessing and exiting the EZ via the CRZ. The decontamination of personnel, PPE, and all equipment occurs in the various decontamination pads that will be set up. Also, the fire watch equipment, wading pool, and water trough (full to the top with water) will be strategically located within the EZ to deal with direct contact with elemental phosphorus.

Figure G-2 is only one graphical representation of the Phase IV ponds layout. It should be noted however, that as site conditions allow and work activities dictate, this proposed layout may be changed as determined necessary by the SHSO.

8. AIR MONITORING AND ACTION LEVELS

8.1 Phosphine Gas Emissions

Phosphine gas emissions shall be monitored in the general work zone and breathing zones for workers operating within the exclusion zone and periodically in the work support areas adjacent to the Phase IV ponds while initial layer slag placement activities are underway. Personal protective equipment will be chosen in accordance with the following action level-criteria:

- If phosphine levels in worker breathing zone (WBZ) range between zero to 0.3 ppm for 8-hours or less, work may proceed in Modified Level D PPE.
- If WBZ phosphine levels range transiently between 0.3 to less than 0.5 ppm for no longer than 5 hours, work may proceed in Modified Level D PPE. If the phosphine level stays consistently (>15 minutes) above 0.3 ppm, Level B protection must be instituted until phosphine levels return to less than 0.3 ppm

and remain stable for at least 30 minutes. However, workers shall not be exposed to 0.5 ppm or greater during a 5 hour time period. Workers shall not be exposed for one minute to phosphine levels greater than 0.3 ppm without the use of respiratory protection.

- If WBZ phosphine levels exceed 0.5 ppm for one minute, PPE shall be upgraded to Level B until phosphine levels return to less than 0.3 ppm and remain stable for at least 30 minutes.
- Anytime during a shift an employee is exposed twice to levels of 1.0 ppm or greater for one minute or more without breathing supplied air, the employee cannot receive anymore phosphine exposure during that scheduled shift.

The SHSO may temporarily close the job to allow dissipation of phosphine to levels below 0.3 ppm.

8.2 Silica Dust Emissions

Dust emissions shall be monitored continuously in the general work zone and periodically in the breathing zones of workers operating within the exclusion zone and periodically in the work support areas adjacent to the Phase IV ponds while slag placement activities are underway. Personal protective equipment will be chosen in accordance with the following action level-criteria:

- If WBZ dust levels exceed 0.1 mg/m^3, which is one-half the calculated OSHA Permissible Exposure Limit (PEL) of 0.2 mg/m^3 (based on a 50% crystalline silica [SiO_2] content) for silica, personnel will don half or full face negative pressure air purifying respirators (Level C) and monitoring will continue. Level B protection shall be used as protection against silica exposure if breathing zone total dust levels exceed 0.5 mg/m^3. Note that a requirement for Level B PPE due to phosphine gas emissions supersedes any requirements based upon dust monitoring alone. NOTE: air purifying respirators are not acceptable for protection against phosphine!

9. DECONTAMINATION PROCEDURES

The decontamination process is used to control the spread of hazardous materials from the EZ through the CRZ to the SZ. Decontamination of items in the following categories will be required: vehicles, tools, and field equipment (including sampling equipment); PPE and apparel; and personnel. The decontamination station will be contiguous with both the exclusion and support zones. Note that decontamination of haul trucks transporting fill to the perimeter of the EZ will not be required prior to their leaving the zone provided they do not enter areas of potential surface contamination.

The SHSO will ensure that the following procedures are implemented at the site:

- All workers will follow appropriate decontamination procedures in accordance with this closure plan.
- The SHSO will ensure availability of decontamination equipment (i.e., detergent, rinse solution, wash tubs, brushes, paper towels, and plastic bags) at the station.
- Chemical splash protective goggles and face shields will be worn during decontamination activities using a pressure washer or steam cleaner.
- All large equipment entering the EZ will remain in that zone until no longer needed or repair or maintenance are necessary. Decontamination of those portions of the equipment contacting phossy waste (excavator bucket, etc.) will be performed within the zone as needed. Once the equipment is released, it will undergo final and complete decontamination at the designated decontamination station prior to leaving the site. (Haul trucks are exempted as detailed above.)
- Mobile equipment and support equipment will be decontaminated using a combination of mechanical means (scraping, etc.), pressure wash and steam cleaning, using stiff brushes and industrial-grade detergent, as necessary, followed by a triple rinse. The cleaning/rinsing process will be repeated, as necessary, until visual inspection confirms satisfactory cleanup.
- Whenever personnel exit the EZ, decontamination will proceed in the sequence described below:

    1. Deposit all equipment used on site (tools, sampling devices and containers, monitoring instruments, clipboards, etc.) on plastic drop cloths. During hot weather operations, a cool-down station may be set up within this area.
    2. Drop leather gauntlet gloves on temporary holding location for reuse upon EZ re-entry. If chemical resistant gloves are not worn under the outer leather gloves, don latex gloves (available at the decon station). Remove hard hat and eye and face protection. Scrub eye and face protection (replace eye protection immediately prior to continuing sequence!), hard hat, gloves, and rubber boots (or boot covers), with decontamination solution or detergent and water. Rinse copiously with clean water. Waste decontamination water will be disposed of as described in Sections 7 and 8 of this Closure Plan.

3. Remove outer boots, if used. Deposit in container for drying and subsequent use.
4. Remove inner boots (if necessary).
5. Remove coveralls and dispose of in waste container if contaminated or at end of shift.
6. Remove respirator, wash, rinse, and hang to dry. Avoid touching face with fingers while removing.
7. Remove hearing protection (if worn). Deposit disposable hearing protection in waste container. Clean, dry, and properly store reusable hearing protection.
8. Remove chemical resistant or latex gloves. Deposit in waste container if disposable.
9. Thoroughly wash hands, face, and neck.
10. Proceed into SZ through appropriate checkpoint.

- After decontamination procedures are completed, workers will thoroughly wash their hands and all exposed skin surfaces before taking a break, eating, smoking, or using the toilet facilities.
- After daily field work is completed, outer protective clothing will be removed and discarded as required. Respirators will be thoroughly washed, sanitized, dried, and properly stored for next-day use.
- Disposable PPE gear will be accumulated in waste containers and transported to an on-site landfill.
- All run-off and any sludges will be containerized; decontamination rinsate and sludge will be disposed of in accordance with Sections 7 and 8 of this Closure Plan.

10. GENERAL SAFE WORK PRACTICES

The following safe work practices will be enforced during closure of the waste management unit:

- Eating, drinking, chewing gum or tobacco, and smoking are prohibited in any area.
- No smoking will be permitted except at specifically designated areas at FMC.
- Practice good personal hygiene such as washing hands and face.

- Portable emergency eyewash stations capable of delivering a constant dual stream for a minimum of 15 minutes will be located at all work stations.
- All wastes generated from the project activities (soiled PPE, decontamination waste, etc.) will be contained and disposed in accordance with Sections 7 and 8 of this Closure Plan.
- Personnel on site must use the "buddy system" when working in the EZ. Communication between members must be maintained at all times.
- No entry into confined spaces of any kind is permitted without first obtaining and executing a Confined Space Entry Permit. Note: All requirements of the FMC Confined Space Policy (SAF-GEN-862) and subcontractor's confined space procedures must be met.
- Facial hair on personnel that interferes with a satisfactory fit of respiratory protective equipment will not be allowed.
- All personnel on site are to be thoroughly briefed regarding the anticipated hazards, protective equipment requirements, safety and safe work practices, emergency procedures, and communication methods.
- Contact with potentially contaminated substances will be avoided (i.e., puddles, mud). Kneeling on the ground or sitting on equipment and placing work equipment or tools on contaminated surfaces will be avoided.

11. TRAINING AND MEDICAL SURVEILLANCE

All site workers and visitors to the site will be required to satisfy OSHA requirements for HAZWOPER training and Medical Surveillance as per 29 C.F.R. §1910.120. Prior to commencement of work, all personnel will submit a copy of their current HAZWOPER training (within the last year), respirator fit test, and medical qualification certificates (respiratory qualifications/pulmonary function test, annual physical, hearing tests, etc.) to the SHSO.

11.1 Training

In addition to the basic health and safety training required in 29 C.F.R. §1910.120, site-specific training/orientation for project personnel will be required. This training/orientation will consist of three basic elements: FMC facility safety training; elemental phosphorus hazards, protection and control; and standard and site-specific hazardous waste site operations health and safety orientation. On-Site Tool Box Safety Meetings will also be conducted by the SHSO or his/her designee daily before beginning any work shift or as frequently as needed to further assist personnel in conducting their activities safely. Tool Box Safety Meetings will be documented on the Tool Box Safety Meeting report form provided in Figure G-3.

Job No. ________

I certify that the attached "safely speaking" material was read and explained to the personnel whose signatures are on the back of this form.

Craft: ______________ Foreman: ________________ Date: ______________

Where meeting held: ____________________________ Time meeting held: ______________

Names and craft numbers of personnel absent: ________________________________

Topics discussed: ________________________________

Safety questions and/or recommendations developed during the meeting: ________________

General foreman's signature ________________________________ Date ______________

Action taken on above suggestions or questions: ________________________________

Superintendent's signature ________________________________ Date ______________

Action taken on above suggestions or questions: ________________________________

All personnel attending this meeting must sign the back of this report.

Route the report in the following order:

1. General foreman
2. Craft superintendent
3. Safety department

FIGURE G-3 TOOL BOX SAFETY MEETING REPORT

11.2 Medical Surveillance

The FMC Pocatello facility is a RCRA interim status hazardous waste facility. Medical surveillance programs are in place for all workers. These programs include respiratory qualification; baseline, periodic, and termination exams; and special programs as required. It is not anticipated that any additional programs will be needed for FMC employees.

12. CONTINGENCY PLAN

In the event that conditions require an emergency response to an on-site fire or natural disaster, all field personnel will be familiar with and follow the procedures described below.

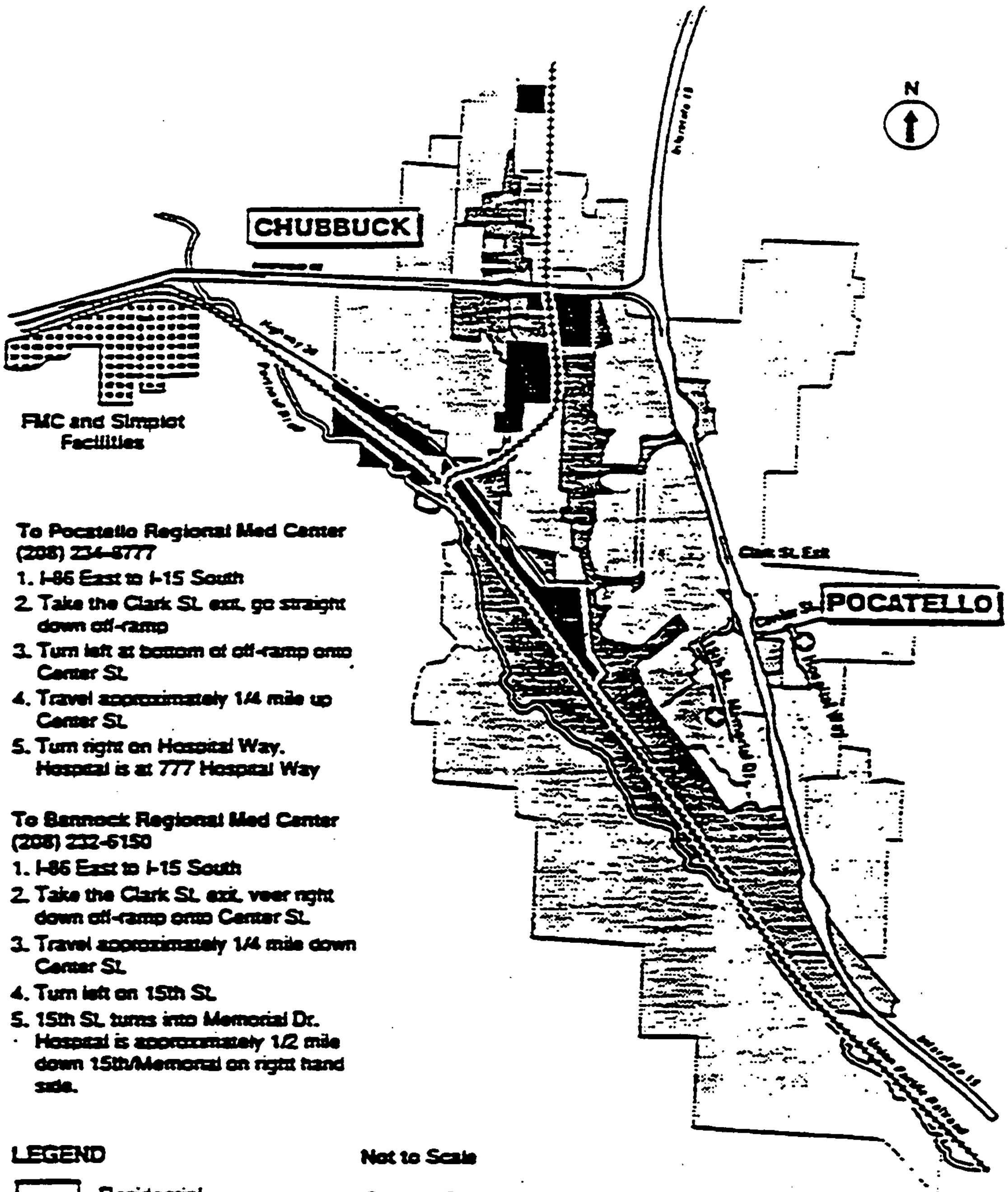
12.1 Emergency Services

The SHSO will ensure that methods and devices used to communicate with the security staff, the local police, fire and ambulance services, and hospital facilities are known to all project personnel. All personnel will be provided with clear and concise directions and accessible transportation to local emergency services. A map highlighting the emergency route to the designated emergency facility and all emergency numbers will be posted in the Support Zone (Figure G-4).

12.2 Project Contacts

A list of emergency telephone numbers for key personnel will be included as shown below:

Task Manager Name: TBD	Work phone: Home phone:
SHSO Name: TBD	Work phone: Home phone:
SHSO Alternate Name: TBD	Work phone: Home phone:
FMC Contact Name: TBD	Work phone: Home phone:
FMC Radio Frequency: Channel 2	
FMC Security (Gatehouse) for medical, fire, or emergency contact	On-site phone: 55 Dialing from off-site: 236-8236



To Pocatello Regional Med Center
(208) 234-8777

1. I-86 East to I-15 South
2. Take the Clark St. exit, go straight down off-ramp
3. Turn left at bottom of off-ramp onto Center St.
4. Travel approximately 1/4 mile up Center St.
5. Turn right on Hospital Way. Hospital is at 777 Hospital Way

To Bannock Regional Med Center
(208) 232-6150

1. I-86 East to I-15 South
2. Take the Clark St. exit, veer right down off-ramp onto Center St.
3. Travel approximately 1/4 mile down Center St.
4. Turn left on 15th St.
5. 15th St. turns into Memorial Dr. Hospital is approximately 1/2 mile down 15th/Memorial on right hand side.

LEGEND

- Residential
- Commercial
- Industrial
- EMF Site
- Hospitals

Source: City of Pocatello / City of Chubbuck Zoning District Maps – April 1990

FIGURE G-4 ROUTE TO HOSPITALS

12.3 Emergency Evacuation from Contaminated Areas

Personnel requiring medical attention will be evacuated promptly from any hazardous or contaminated area. Special decontamination treatment and/or procedures will be provided for any injured person. In the event of personnel contamination with phossy wastes, emergency decontamination (full immersion) will take precedence over evacuation provided the immediate area of the emergency decontamination facility is not hazardous.

Only qualified personnel will give first aid and stabilize any employee needing assistance. First-aid attendants shall be currently qualified in American Red Cross or equivalent first aid and CPR. Professional medical assistance will be obtained immediately should life-threatening problems arise. FMC will provide and maintain a first-aid kit and portable pressurized eyewash facility as discussed previously at the work location. The evacuation procedures that are to be followed are those developed by FMC for their plant. Specific details for the emergency procedures are included in the EMF RI/FS Health and Safety Plan (Bechtel 1992).

12.4 Emergency Actions

If any emergency involving actual or suspected personal injury occurs, the SHSO or designated person will follow these steps:

- If there is no danger to the rescuer, remove the exposed or injured person(s) from immediate danger.
- Render first aid if necessary. Decontaminate affected personnel after life sustaining and critical first aid is given.
- For emergencies occurring in the FMC facility, determine the incident level by contacting Plant Security (Gatehouse) over the radio network or by calling 55 on the plant telephone or 236-8236 from a non-plant telephone. Details of the procedures to be followed are identified in the FMC Incident Response Plan maintained on the FMC premises. Obtain emergency paramedic services or ambulance transport to local hospital by calling 911 for emergencies that occur outside the FMC site.
- If necessary, decontaminate all other affected personnel in the area and evacuate to a safe distance until the SHSO determines that it is safe to resume work.
- At the earliest practical time, contact the FMC Health and Safety Manager and FMC Project Managers to give them details of the incident and steps that have been taken to prevent its recurrence.

- Provide a written report of the incident to the FMC Health and Safety Manager and FMC Project Managers within 24 hours following the incident. Fill out an FMC Incident Report Form for all incidents/accidents involving employees.

13. REFERENCES

Bechtel 1992. Health and Safety Plan for Remedial Investigation/Feasibility Study, Eastern Michaud Flats Site, Idaho, for FMC Corporation, by Bechtel Environmental, Inc., February 1992.

ATTACHMENT G-1

CONTRACTOR SAFETY REQUIREMENTS

CONTRACTOR REQUIREMENTS

This document identifies the safety and health requirements for all **CONTRACTORS** and service vendors performing work at the FMC Corporation plant in Pocatello, Idaho. Prior to acceptance of a contract and/or purchase order, and prior to starting work, **CONTRACTORS** must comply with all FMC Pocatello safety policies and procedures, as well as applicable safety and health regulations from the Occupational Safety and Health Administration (OSHA), and the Resource Conservation and Recovery Act (RCRA), and those of any other appropriate regulatory agency.

<u>This document does not pertain to those **CONTRACTORS** who provide incidental services which do not influence process safety, such as janitorial work, food and drink services, laundry, delivery and other supply services.</u>

An overview of the safety requirements is provided here in the following pages. For additional information **CONTRACTORS** should refer to the FMC Pocatello Safety Manual, government literature, and other reference materials listed throughout this booklet. Information is also available from various government agencies and from personnel in the FMC Pocatello Safety Department (also identified herein as "the Safety Department"), or from an FMC representative appointed to the **CONTRACTOR** prior to work.

FMC Pocatello requires **CONTRACTORS** and Service Vendors to make a commitment to all areas of safety as a condition for the acceptance of the Contract and/or Purchase Order. Serious and/or consistent violations of safety and health standards, potential hazards and other such safety related problems, can result in termination of the contract agreement.

Subcontractors will be subject to the same requirements as those of the **CONTRACTOR.**

CONTRACTORS who are awarded work by FMC will be granted permission to enter the plant by the FMC Purchasing Department once all safety prerequisites are met.

All records required of the CONTRACTORS by FMC must be delivered to the FMC Purchasing Department.

SAFETY AND HEALTH PRE-QUALIFICATIONS QUESTIONAIRE:

Companies or persons who are requested to submit a bid or proposal to perform contract work at the FMC Pocatello plant may be required to complete a Pre-Qualification Safety Questionnaire. This questionnaire will assist in evaluating **CONTRACTOR'S** safety and health programs. For **CONTRACTORS** who have been assigned work prior to implementation of this questionnaire, completion of the questionnaire will be upon request by FMC for re-qualification.

SAFETY AND HEALTH MINIMUM REQUIREMENTS:

CONTRACTOR is required to maintain current knowledge of all FMC Pocatello requirements and of all government regulations as applicable to all CONTRACTOR supplied equipment. Each CONTRACTOR is directly responsible for the use and condition of any equipment provided by the CONTRACTOR at the FMC plant site. All required equipment inspections and certifications are to be retained at the job site while using the equipment at the FMC plant site.

CONTRACTOR is responsible to supply any/all needed information, such as Material Safety Data Sheets (MSDS), for all materials and substances brought to the FMC plant site by CONTRACTOR.

Each CONTRACTOR is ultimately responsible for the safety and health of his/her employees. CONTRACTOR will provide a designated individual(s) who will be able to identify unsafe conditions and practices in the work area, to take appropriate corrective actions, and to assure each employee is using the proper safety equipment, procedures and suitable tools for each task.

CONTRACTOR is required to adhere to the latest revision of all applicable FMC policies and procedures while working at the FMC Pocatello Plant. The depth and breadth of these requirements may vary depending on the type of activity involved and the area in which the work is to be performed. To assist CONTRACTOR in determining requirements set forth by FMC, copies of the "basic" policies of FMC may be viewed and copied on the Master Control System. These policies include, but are not limited to the following:

- General Plant Safety Rules (SAF-GEN-801)
- Respiratory Protection (SAF-GEN-842)
    - Pulmonary Function Testing & Dr. Certification
    - Respirator Fit Test
- Confined Space (SAF-GEN-862)
- Lockout/Tagout (SAF-LTV-801)
- Barricades (SAF-GEN-807)
- Fall Protection (SAF-GEN-803)
- Welding, Cutting, Burning (SAF-GEN-806)
- Safe Use of Scaffolding (SAF-GEN-808)
- Electrical Work - GFCI's (SAF-GEN-878)
- Entering Trenches & Excavations (SAF-GEN-822)
- Hair, Beards, and Mustaches (SAF-GEN-843)
- Minimum Dress Standards (SAF-GEN-844)
- Substance Abuse Policy Guidelines

PRE-JOB SAFETY CONFERENCE:

At FMC's discretion, to determine specific safety needs before work begins, a conference meeting may be conducted with the **CONTRACTOR SUPERINTENDENT,**

CONTRACTOR SAFETY REPRESENTATIVE (or designate), the FMC Project Manager and/or the Purchase Order Requisitioner (or designate) and a member of the FMC Safety Department. This conference will enable each attendee the opportunity to:

- Identify representatives to be contacted regarding hazards and safety and health requirements.
- Clarify **CONTRACTOR's** supervisory responsibilities.
- Reaffirm and confirm understandings of requirements (i.e.: Safety Policies - overlays of FMC policies vs. OSHA requirements), the risks of non-compliance, and benefits of compliance.
- Discuss specific safety and health activities that must be addressed by **CONTRACTOR.**
- Review **CONTRACTOR** employees training requirements/schedule.
- Discuss access to project site and work area.
- Identify record keeping Requirements
- Review Personal Protective Equipment (PPE) Requirements.

CONTRACTOR EMPLOYEE SITE ORIENTATION:

FMC will provide CONTRACTOR employees with a facility/site orientation class prior to commencement of work. The purpose of this training is to make each contract employee aware of known hazards to which they may be exposed, appropriate precautionary measures, and additional emergency response procedures.

This orientation does not relieve CONTRACTOR of responsibility to provide safety and health training for its employees. CONTRACTOR also is responsible to determine a method to measure comprehension of the training information. Such methods may include written and verbal examinations, walk-throughs, demonstrations, spot questioning during the work, etc. (Copies of OSHA training requirements are listed but not limited to, those in attachment #2). The training records are to be maintained by CONTRACTOR and to be made available for review by FMC upon request. **Employees who will be utilized for Confined Space Entry must provide certification of satisfactory completion of training prior to assignment.**

INSPECTIONS AND AUDITS:

FMC reserves the right to inspect or audit CONTRACTOR'S site or office records on a demand basis. This may include but is not limited to:

- CONTRACTOR'S Laydown Area and job-site
- Material Handling Equipment and Procedures
- Accident and Incident Summaries
- Record Keeping
    - Substance Abuse Program

- Respiratory Fit Testing
- Employee Logs and Training
- Safety Meeting Programs and Logs
- Equipment Certification and Inspections

ATTACHMENT #2

Regulatory Requirements for Selected Work Activities

If You Do This Work	You Must Comply With			
	General Industry [illegible] 1910	Construction [illegible] 1926	Other	[illegible] EMC Policy
Confined Space Entry	.146			SAF-GEN-862
Personal Protective Equipment	Subpart I			SAF-GEN-844
Eye	.133	.102		SAF-GEN841
Head	.135	.100		
Respiratory	.134	.100		SAF-GEN-842
Elevated Work		Subpart 500		SAF-GEN-803
Record Keeping	.440		29 CFR 1904	
Electrical Tools	Subpart P & S	.404		SAF-GEN-878
Abrasive Wheel Tools	.215	.303		
Scaffolding	.28	.451		SAF-GEN-808
Ladders	.26	Subpart X		SAF-GEN-809
Welding	Subpart Q	.350 .351		SAF-GEN-806 2.3.2
Fire Exits	.157	.150		
Electrical Systems	Subpart S	.400		SAF-GEN-876
Trenching/Excavation		.650 .651 .652		SAF-GEN-822
Noise	.95			SAF-GEN-865
Emergency Response	.138 .120			
Barricades				SAF-GEN-807
Lockout/Tagout	.147			SAF-LTV-801
Asbestos	.1001	.58	40 CFR 61 Part M	SAF-GEN-866
Crane Suspended Personnel Platform		.550		SAF-GEN-812
Materials Handling (Crew/Rigging)				SAF-GEN-811
Hazardous Communications	.1200			SAF-GEN-893
Radiation Protection	.96 .97			SAF-GEN-863
Cranes	.180	.550		SAF-GEN-811 SAF-GEN-880
Aerial Lifts		.556		SAF-GEN-812
Motor Vehicles		.601		
RCRA (Waste Disposal)			40 CFR 265	

SPECIAL CONDITIONS

SPECIAL CONDITIONS OF THE CONTRACT

SUBSTANCE ABUSE POLICY GUIDELINES FOR CONSTRUCTION CONTRACTORS

FMC has a strong commitment to its employees to provide a safe and healthy work place and to establish programs promoting high standards of employee health and safety. Consistent with the spirit and intent of this commitment, FMC has established this Special Condition of the contract regarding drug and alcohol abuse for its contractors and subcontractors of any tier ["**CONTRACTOR**"] who perform work (services, deliveries, inspections, etc.). It is FMC's desire to continue the establishment and maintenance of a work environment that is free from the effects of drug and alcohol abuse.

C. <u>MINIMUM REQUIREMENTS</u>:

FMC requires, and **CONTRACTOR** agrees, as a condition of acceptance , to adopt and enforce a written drug and alcohol abuse policy. **CONTRACTOR'S** policy shall be consistent with and at a minimum, contain the following requirements:

A. **CONTRACTOR** agrees to notify its **CONTRACT WORKERS** of the contents and requirements of its policy. For purposes of these Guidelines, a **CONTRACT WORKER** is any employee, associate, agent, representative, (assignee) or successor in interest who performs work (services, deliveries, inspections, etc.) on FMC property or in the course of FMC related business.

B. **CONTRACTOR'S** policy shall be in complete compliance with any and all federal, state, and local governmental regulations and legal requirements in effect for the applicable FMC location.

C. The minimum requirements for **CONTRACTOR'S Substance Abuse Policy** shall include, but need not be limited to, the following or similar provisions:

1. The use, abuse, presence in the body or reporting to work under the influence , bringing onto company property, unlawful manufacture, distribution, dispensation, possession, purchase, transfer, storage, concealment, transportation, promotion, or sale of any **ILLEGAL AND UNAUTHORIZED DRUGS, SYNTHETIC/DESIGNER DRUGS, CONTROLLED SUBSTANCES (EXCEPT LEGALLY PRESCRIBED DRUGS) OR DRUG RELATED PARAPHERNALIA BY CONTACT WORKER** is strictly prohibited on all company properties, job sites or work areas during work hours and/or while on FMC property or on FMC related business.

2. The use, abuse, presence in the body or reporting to work under the influence, bringing onto company property, unlawful manufacture, distribution, dispensation, possession, purchase, transfer, storage, concealment, transportation, promotion or sale of alcohol by any person is strictly prohibited on all company properties job sites or work are as during work hours and/or while on FMC property or on

FMC related business. In addition, it is strictly prohibited for any **CONTRACT WORKER** to have a blood alcohol level (BAC) at or over 0.04% during working hours or whole operating machinery or other equipment while on any company property, job site or work area and/or while on FMC property or on FMC related business.

3. **CONTRACT WORKERS** undergoing prescribed medical treatment with a prescription drug or using over-the-counter preparations (including, but not limited to, painkillers or tranquilizers) that may affect their performance shall report this treatment use to **CONTRACTOR'S** authorized supervisor. **CONTRACTOR** will determine whether worker can remain at work, and whether medical consultation or work restrictions are required.

4. **ILLEGAL DRUGS** are described as, but not limited to, marijuana (pot, dope, hash or hashish), cocaine (coke, rock, crack or base), LSD (acid), PCP (angel dust, crystal), MDMA (ecstasy), heroin (smack, black tar), opium (morphine, white stuff, tar, black stuff), or any other unauthorized or unlawfully obtained drugs.

   DESIGNER AND SYNTHETIC DRUGS are described as, but not limited to, ice/ice cube, crank, china white, synthetic heroin, MDA, Adam, Eve, Love Drug or any other drugs that are made in clandestine laboratories where the chemists alter the molecular structure of legal or illegal drugs to create a drug that is not specifically banned by federal law.

   UNAUTHORIZED ALCOHOLIC OR INTOXICATING BEVERAGES are described as, but not limited to, beer, wine or liquor.

D. <u>COORDINATION WITH FMC</u>:

A. FMC, through its authorized representatives and agents, reserves the right, at all times, while on the FMC premises and properties and as circumstances warrant, to search and inspect **CONTRACT WORKER'S** possessions, including but not limited to, their lockers, baggage, desk, clothing, tool boxes, lunch boxes, brief cases vehicles or any other such repositories for the purpose of determining if such **CONTRACT WORKERS** are in possession, use, transportation, or concealment of any of the items or substances prohibited by the policy guidelines. Any **CONTRACT WORKER** found to be in violation of these Guidelines shall be removed immediately pending further investigation. If violation is substantiated, administrative action up to and including removal and barring from FMC property will be imposed.

B. **CONTRACT WORKERS** on FMC sites shall be certified substance free prior to commencement of work on the FMC site.

1. <u>PREACCESS TESTING</u>:
CONTRACTOR agrees to certify to FMC that every one of its **CONTRACT WORKERS** assigned to FMC has been tested and confirmed negative for substance abuse within the previous thirty (30) days of assignment to an FMC site and that the test has been confirmed negative for illegal substances as described in Paragraph 1.3 and defined in Paragraph C, **CONTRACT WORKERS** who have been absent from an FMC site for a period of thirty (30) days or longer are considered to be new assignees should they return to the site for work, and as such **CONTRACTOR** shall certify to FMC that the **CONTRACT WORKER** has been tested and confirmed negative for substance abuse within the previous thirty (30) days of their reassignment.

2. <u>CURRENT EXISTING CONTRACTS</u>:
CONTRACTOR further agrees that within thirty (30) days after these Guidelines are implemented at an FMC site, all of its **CONTRACT WORKERS** already assigned to the FMC site shall be tested and confirmed negative for substance abuse, although they may continue in their assignment while awaiting test results.

3. <u>CONTRACT WORKER ANNUAL TESTING</u>:
Annually, **CONTRACTOR** shall certify to FMC that every one of its **CONTRACT WORKERS** continuously assigned to an FMC site for a period of one year, or longer, has been tested and confirmed negative for substance abuse within thirty (30) days of the anniversary date of assignment to the FMC site. Any CONTRACT WORKER testing positive for drugs or alcohol and properly confirmed shall be removed from any work assignment on an FMC site.

C. **<u>"For Cause"</u>** testing of any **CONTRACT WORKER** (Including Urine and Blood Sampling and/or Breath Analysis Testing) may be conducted without prior announcement when there is a reasonable suspicion. It shall be the responsibility of the **CONTRACTOR** whose worker is being tested to have the appropriate test(s) performed when reasonable suspicion exists. Testing will be performed with concern and respect for the personal privacy and dignity of the **CONTRACT WORKER**. "For Cause" is defined by, but not limited to, the following circumstances:

1. When a supervisor has reasonable suspicion or cause to suspect that a **CONTRACT WORKER** shows signs of possible intoxication, is using or under the influence of drugs or alcohol, or when other articulable facts would lead a prudent supervisor to be concerned about the individual's safety or the safety of the general public and others due to the **CONTRACT WORKER'S** physical condition or behavior while working.

2. **<u>A urine and/or blood test is required when a CONTRACT WORKER is found in possession</u>** of suspected illicit or unauthorized drugs and/or alcohol, drug paraphernalia or when any of these items are found in an area used exclusively by designated **CONTRACT WORKERS**.

3. **<u>A urine and/or blood test is required</u>** when a **CONTRACT WORKER** suffers an on-the-job injury which requires a visit to a doctor (as allowed by law) or following a serious or potentially serious accident or incident in which safety precautions were violated, unsafe instructions or orders were given, equipment or property was damaged (including, but not limited to, automobiles, trucks and other equipment), unusually careless acts were performed, or where the cause was due to a **CONTRACT WORKER'S** failure to wear prescribed personal protective equipment, or follow prescribed safety rules while working on company premises or while on FMC property or FMC related business.

4. In the case of unusual circumstances where employee error cannot be ruled out, FMC reserves the right to demand urine and/or blood tests conducted for all involved **CONTRACT WORKERS**.

E. <u>ENFORCEMENT</u>:

A. **CONTRACTOR** shall be responsible for and shall monitor all substance testing of its **CONTRACT WORKERS** assigned to an FMC site. All testing results shall be confirmed to FMC's Project Manager or FMC's designated contact by the **CONTRACTOR**. Upon request, **CONTRACTOR** shall furnish to FMC a completed and signed certification in the form of Exhibit A for each **CONTRACT WORKER** as requested.

1. **CONTRACTOR** shall keep and maintain all records pertaining to the substance abuse testing conducted for the FMC site for the life of the contract under which the work was performed plus one full year after the fulfillment of the contract or as long as required by law, whichever period is longer.

2. **CONTRACTOR** agrees to allow FMC or its agent full and complete access to its substance abuse program and to all substance abuse testing records related to applicable FMC sites for the purpose of auditing those records.

3. **CONTRACTOR** shall immediately notify FMC's Project Manager or the designated FMC contact of all positive test results. This notification shall be followed by written confirmation.

4. **CONTRACTOR** shall not allow any **CONTRACT WORKER** access to an FMC site until all substance abuse tests have been confirmed negative if that **CONTRACT WORKER** was tested under any of the "For Cause" provisions in paragraph C.

5. Prior to the return to work of any **CONTRACT WORKER** on an FMC site, who is removed under one of the "For Cause" provisions of paragraph:C., **CONTRACTOR** shall obtain a written statement from a properly licensed and practicing physician certifying that the **CONTRACT WORKER** is fit for duty (able to perform the exact same job and functions being performed when the **CONTRACT WORKER'S** behavior triggered the original test).

6. **CONTRACTOR** shall not allow access to any FMC site to any **CONTRACT WORKER** who has been removed from any site for substance abuse and whose substance abuse test has been confirmed positive until that **CONTRACT WORKER** has successfully completed an approved counseling and/or rehabilitation program and has remained "clean" for at least a three month interval for the next year. A second positive test for any such **CONTRACT WORKER** shall result in their being denied access to any FMC site.

B. Substance testing shall be conducted by a properly qualified and competent laboratory which follows the standards of and is certified/accredited by the National Institute on Drug Abuse (NIDA). Laboratory qualifications shall be furnished to FMC's Project Manager or FMC's designated contact on a yearly basis or on demand. All samples shall be collected, sealed and transported according to the chain-of-custody protocol as defined by NIDA. Unless otherwise bound by existing laws, statutes or agreements, testing shall include, as a minimum, the following types and allowable levels of substances.

SUBSTANCE	EMIT (nanograms/ml)	GC-MS LEVEL (nanograms/ml)
Amphetamines	1000	500
Alkaloids, Opiates (Heroine, Morphine, Codeine)	300	300
Benzoylegonine (Cocaine)	300	300
Phencyclidine (PCP, Angel Dust)	25	25
Cannabinoids (THC, Marijuana)	50	15

C. **CONTRACTOR** shall insure that all **CONTRACT WORKERS** assigned to an FMC project or site read and sign a copy of Exhibit B, which confirms that **CONTRACTOR'S** substance abuse policy applies to all work performed on an FMC site or while on FMC related business and which provides notice of FMC's right to conduct or to have conducted searches in accordance with these Guidelines. A copy of the completed and signed statement must be on file with **CONTRACTOR** prior to assignment of such Workers, except as provided in Paragraph.B.2.

D. Violation of any of the provisions of these Guidelines is strictly prohibited and will be proper cause for administrative action by FMC, up to and including termination of this contract and removal and barring of the **CONTRACTOR** from FMC property.

E. Prior to the commencement of work, **CONTRACTOR** shall place on file with FMC's Project Manager or FMC's designated contact its Substance

Abuse Policy and written procedures for the implementation and administration of that policy.

END OF TEXT

EXHIBIT A

WORKER PREASSIGNMENT SUBSTANCE TEST CERTIFICATION

WORKER NAME____DATE:_____

SOCIAL SECURITY NUMBER_____________________EMPLOYER_____________

DATE SAMPLE TAKEN__________________________

NAME OF TESTING LABORATORY:_______________________________________

TEST UTILIZED FOR SCREEN____

SCREEN TEST RESULTS:____

____

____

____

CONFIRMATORY TEST UTILIZED:____

CONFIRMATORY TEST RESULTS:____

____

____

____

I HEREBY CERTIFY THE ABOVE TEST RESULTS TO BE CORRECT TO THE BEST OF MY KNOWLEDGE.

EMPLOYER'S NAME:____

BY:____

NAME (PRINTED):____

TITLE:____

DATE:______________________________________

VERIFIED BY: PRIME CONTRACTOR NAME:________________________________

BY:____

NAME (PRINTED):___________________________________

TITLE:____

DATE:____

EXHIBIT B

ACKNOWLEDGEMENT AND POLICY STATEMENT

I hereby acknowledge that I have received a copy of my Employer's substance abuse policy. I have read this policy, I understand its provisions and requirements, and I agree to submit to all of its provisions and requirements during my FMC assignment, including provisions related to substance abuse testing. I fully understand that compliance with this policy is a condition of my being allowed to enter and/or remain working on FMC property or on FMC related business.

I also acknowledge that access to any FMC work location, plant site, project site, offices or vehicles is conditional on FMC's right to search the entrant's personal property and effects and vehicle for illegal and/or unauthorized substances, contraband and drug paraphernalia.

Illegal substances as defined by federal and state law and by my employer's substance abuse policy include, but are not limited to, marijuana and hashish, cocaine, heroin, opium, hallucinogens, synthetic and designer drugs, alcoholic or other intoxicating substances, paraphernalia, and depressants or stimulants not prescribed by a licensed physician for current personal treatment.

Worker Signature:______________________________________

Worker Name (Printed)__________________________________

DATE:__________WORKER SOCIAL SECURITY NUMBER _______________

EMPLOYEE BY:____

VERIFIED BY: SIGNATURE ______________________________

NAME (PRINTED)_____________________________

TITLE:____

COMPANY NAME:______________________________

FMC Pocatello, Idaho	SAFETY POLICY CONTRACTOR SAFETY	SAF-GEN-852 Issue Date 01/22/96 Supersedes 2.7.2 Date 1/83 Page 1 of 3
Prepared by: B. Goldade	Approved by:	

Scope
This policy applies to all general contractors, self-employed contractors, subcontractors (general or self-employed) working on construction, maintenance/repair major renovation, turnarounds, or specialty services, in or around process equipment, laboratories, pipelines, terminals and utilities.

NOTE: This policy does not apply to contractors providing incidental services, ie: janitorial work, food and drink services, or delivery personnel.

PURPOSE:
Increase contractor involvement for effective management to minimize occurrences of adverse effects, such as process upsets, incidents, injury, environmental impact or property loss for contractor and FMC employees.

POLICY:
All FMC plant, federal, and state regulations must be followed by contractor employees. Contractor supervisors are responsible to assure their employees work in a safe manner and that their actions do not cause injury to themselves, their co-workers, or FMC employees. It is necessary that all contractors who perform work on FMC property adhere to the following rules:

I. Standard dress for all process areas of the plant include: (For more information, refer to FMC policy SAF-GEN-844)
   A. Full-length pants worn over the tops of the shoes. (No holes)
   B. Long-sleeve shirt or jacket, with sleeves rolled down. (No holes)
   C. Hard hat (ANSI approved - class "B") in good condition.
   D. Safety glasses with permanently affixed side shields. Shaded lenses or shade adjusting lenses are prohibited indoors.
   E. Goggles are to be in each employees possession at all times in the process areas and used as conditions and jobs require.
   F. Safety toed shoes (leather) which cover the ankle, have slip resistant soles, and heels over two inches in diameter. (Rubber boots may be required for specific jobs)
   G. Proper respirator in the designated areas or when potential exposures require it. (See FMC policy SAF-GEN-865)

   It is the responsibility of the contractor management to provide personal protective equipment necessary to assure safe operation to his/her employees. If such equipment is borrowed from FMC, the contractor must return it to FMC in its proper condition.

NOTE: It is the contractor employers responsibility to provide the necessary medical exam, pulmonary function testing, respirator fit test, and training required, for each of their employees before performing work at FMC.

II. The contractor employer is responsible to maintain adherence to FMC requirements of Substance Abuse testing, Confined Space training (SAF-GEN-862), Respiratory Protection (SAF-GEN-842), Hair, Beards, Mustache, and Sideburns (SAF-GEN-843), Minimum Dress Standards (SAF-GEN-844), and all other policies applicable to the type and location of work being performed.

III. Contractor employees must check in and out of the designated stations as they enter or leave FMC property. An identification badge will be issued to each employee upon completion of the Contractor Preliminary Checklist (SAF-GEN-852-B). It will be the employees responsibility to wear the badge in plain sight while on FMC property and his/her responsibility to return it to the contractor supervisor who will return the badge to FMC.

IV. Parking is provided near the west entrance to the plant for all contractor employees. Contractor employees are to park in this designated area only.

V. FMC reserves the right to inspect all vehicles, packages, lunchboxes, etc. upon exiting FMC property. Such inspections will be conducted on a random basis.

VI. Drinking water is to be obtained from the designated sources only. Do not drink water from hoses or unmarked spigots, etc. All drinking water sources are marked "potable water" or "drinking water", or may be from a drinking fountain or water bottle station.

VII. Contactor employees who operate equipment must be trained in the safe operation and certification of such training must be maintained by the contractor management. No FMC equipment or equipment owned or leased by the contractor shall be operated without the proper training.

VIII. Contractor supervision will confine their employees to designated work areas only.

IX. Intoxicants, controlled substances, firearms, ammunition, explosives, and cameras are not permitted on FMC plant property.

X. Smoking is not allowed in any FMC vehicle or building. Smoking is not permitted anytime in areas designated "NO SMOKING".

XI. Specific instructions and FMC policies require proper shut down and Lockout/Tagout before any work is to be performed on equipment. (Refer to the Lockout/Tagout procedures)

XII. Fire fighting equipment will be used for its intended purpose only.

XIII. Personnel will not ride on any equipment except in the passenger seat or inside the bed or body of the vehicle. Riding on tailgates, fenders, bumpers, sitting on sideboards of trucks, or riding in the buckets of loaders is strictly prohibited.

XIV. No persons shall ride on any hook or material being hoisted by material handling equipment.

XV. Practical jokes or horesplay is prohibited on company property.

FMC Pocatello, Idaho	SAFETY POLICY HAIR, BEARDS, MUSTACHES, AND SIDEBURNS	SAF-GEN-843 Issue Date 06/01/95 Supersedes 2.6.8 Date 9/92 Page 1 of 1
Prepared by: D. Byington & Steve Welch	Approved by:	

SCOPE

The purpose of this policy is to establish standards to protect employees' safety and health and comply with Federal Occupational Safety and Health Administration Regulations pertaining to the wearing of respiratory protective devices.

I. **HAIR**

A. Employees working in locations which present a hair catching or fire hazard must maintain their hair close to their head or body.

B. Compliance with this policy does not require the hair to be cut. It does require that the hair be worn so that exposure to moving equipment or flame is limited.

C. The use of a hair net or tucking the hair under the safety hat (must not render safety hat ineffective) will, in most cases, permit compliance with this instruction.

II. **BEARDS, MUSTACHES, AND SIDEBURNS**

A. It is the policy of FMC-Pocatello to comply with paragraph (e), (5), and (i), Section 1910.134 of the Federal Occupational Safety and Health Regulations, pertaining to the wearing of respiratory protection.

B. No employee will be permitted to work in an atmosphere which requires the wearing of a respiratory protective device unless a good seal can be obtained against facial skin.

1. Beards shall not be permitted by any employee or contractor at this facility. All employees and contractors will have to be clean shaven. (Contractors or visitors entering the plant may maintain facial hair depending on task and location (refer to SAF-GEN-842)
2. Mustaches must be trimmed so they do not interfere with the seal of the respirator.
3. Sideburns must be trimmed so they do not interfere with the seal of the respirator.

C. Contractors or visitors entering the plant may maintain facial hair depending on the task and location. (Refer to SAF-GEN-842).

FMC Pocatello, Idaho	SAFETY POLICY MINIMUM DRESS STANDARDS PROCESS AREAS	SAF-GEN-844 Issue Date 06/01/95 Supersedes 2.6.9 Date 1/83 Page 1 of 2
Prepared by: Cindy J.A. Roske	Approved by:	

SCOPE

It is the policy at the FMC plant, for reasons of safety, to require all employees entering the plant process areas to abide by minimum dress and personal protective equipment rules required by this and other plant safety manual standards.

DEFINITIONS:

Process Areas: The area east of and including the stores-maintenance building, and south of the phosphorus spur track.

Non-Process Areas: The area west of the stores and maintenance building north of the phosphorus spur track, and east of the plant parking lot. This includes all office buildings, the changerooms. and laboratory building. (See exceptions below)

I. **REQUIREMENTS** (while working or walking through process areas):

A. Full-length pants to be worn over the top of the shoe. (No holes in clothing)

B. Long-sleeve shirt or jacket, with sleeves worn down. (No holes in clothing)

1. Special jobs may require such protection as Aluminized suits, refer to P4 Minimum Mandatory Standards (SAF-GEN-829).

C. Approved ANSI Class B hard hat in good condition, not cracked or contacted by chemicals, etc. It should be properly adjusted when worn for best protection. It must be replaced at least every five (5) years or sooner as necessary. The only exceptions to this are Stores, Maintenance Shop, Bench Areas, Panelboard Rooms, Boiler-house, cabs of mobile equipment, and traveling to and from women's changehouse and foreman's changehouse. However, they shall be used any time a task involves overhead hoisting.

D. Approved safety glasses with permanent side shields and/or goggles.

1. Special jobs may require face shields for added protection, refer to Eye and Face Protection policy (SAF-GEN-841).

E. Proper respirator in the designated area or when potential exposure requires it. (See Respiratory Protection Policy SAF-GEN-865).

F. Proper gloves

1. Short cloth back, leather palm gloves are permitted in non-process and process areas where no phosphorus risks exist and on tours.
2. Long gauntlet (neoprene or leather-front and back) gloves are required for work being performed in the furnace building, phos dock, secondary condenser, or when any work is performed where phosphorus exposure risks exists.
3. Special protective gloves may be required for other jobs such as welding, chemical work, or electrical work, etc.

G. Proper shoes:

1. Shoes or boots made of leather, which cover the ankle, have slip resistant soles, safety toes, and heels over two inches in diameter should be worn while working in any process area in the plant. Safety toed shoes shall be required after July 1, 1995 for all process areas.
2. Specific jobs may require special safety protection such as rubber boots.

NOTE: Rubber covers for visitors shoes on tours will be provided at the gatehouse if needed, as well as other PPE. Light weight, wind-breaker type jackets are only allowed for visitor use.

The laboratory does require safety glasses, goggles, or face shield and gloves (when necessary) plus long-sleeve shirts, pants, but not the safety toed shoes.

FMC Pocatello, Idaho	SAFETY POLICY		SAF-GEN-801
	PLANT SAFETY RULES (GENERAL)		Issue Date 4/99 REV 2 Supersedes 2.1.1 Date 11/98
		Final	Page 1 of 2
Prepared by:		Approved by:	Paul Yochum

SCOPE
General plant safety rules should compose the code of conduct expected of all employees. They frequently will refer to more detailed policies and procedures contained in the plant electronic document control system.

I. **GENERAL SAFETY RULES:**
Below are listed examples of general plant safety rules.

A. Report any work connected injuries/illnesses, near misses or hazardous situations occurring in the plant, no matter how minor, as soon as practicable*, but before leaving the plant. The procedure for reporting is as follows: (*Except in cases where the injury renders the employee unconscious or disabled, "as soon as practicable" means immediately following administration of primary first aid).

1. If possible, report the injury to your shift manager and request permission to report to the dispensary or to the guard in the gate house for medical attention.
2. If your shift manager is not available, ensure your job responsibilities are properly covered before reporting to the dispensary or to the guard on duty. Report to your shift manager as soon as possible after receiving medical attention, but no later than departure from the plant.
3. Any employee injured at the plant who after reporting it, requires medical attention once they have left the plant, must contact the guard on duty for assistance in obtaining the proper medical attention. (Refer to the Incident Response Plan Section 5.0 or your shift manager).

B. An approved safety hat must be worn at all times on company property except in office areas enclosed with four walls and a roof; the Stores and Maintenance building, the Boiler House, Panel Board rooms., the Change House, area west of the Stores and Maintenance building north of the Phosphorus Spur Track, and east of the plant parking lot. Hard hats need not be worn in the cabs of mobile equipment, while walking from the Main Office complex to the Phosphorus department offices, or from the in-plant parking area to the Main Office complex. In addition, hard hats must be worn immediately outside all Mobile shop doors, unless it is absolutely impossible to wear a hat inside machinery compartment during maintenance/service activities where head space is restricted. While performing work in the Mobile Shop bench area, hard hats will not be required. All other areas inside the shop, hard hats are required except when it is not feasible while bending over or working inside or under machinery while actually performing work.

C. Primary eye protection in the form of safety glasses with side shields must be worn in all stores, maintenance and electrical shops, tool rooms, labs, and all other process areas, excluding control rooms. Other exceptions are traveling between office buildings, change rooms, and coming to and from employee parking lot.
Eye protection in the form of safety goggles, face shields, full face respirators, welding hoods, sandblasting hoods, etc. and other related details will be in accordance to safety policy SAF-GEN-841, Eye and Face Protection.

D. Approved respiratory protection must be worn in those areas so labeled and is required to be on-person in all process areas.

E. Each employee shall wear additional personal protective equipment as instructed by his/her shift manager or dictated by departmental safety policies.

F. No employee shall operate any equipment other than that necessary to perform his assigned duties.

G. Danger tags, caution tags, and lockout/tagout tags shall be used according to Lockout/Tagout procedures.

H. Personnel will not ride on any equipment except in a passenger seat or on the inside of the bed or body of a truck equipped with sideboards. Standing in the bed, on tailgates, fenders, bumpers and/or sitting on sideboards, tailgates, fenders, bumpers or riding in the buckets of front-end loaders is strictly prohibited. Two persons in the cab of a single seated machine (i.e. front-end loaders, forklifts, etc.) will be allowed for training purposes only.

I. No employee shall ride on any conveyor, hook, sling, load, or material being transported.

J. Excavations and hazardous work areas shall be provided with warning signs and properly erected barricades.

K. Each employee shall maintain good housekeeping in his/her assigned work area.

L. Each employee shall comply with all regulatory signs posted within the company property. Creation or replacement of all safety signs shall be in accordance with SAF-GEN-816.

M. Only ladders that are in safe condition are to be used. All ladders being used must have had current inspection as outlined in the plant ladder safety policy.

N. Unsafe conditions should be reported immediately to your shift manager.

O. Fire fighting equipment shall be used for fire fighting only unless otherwise authorized by your shift manager. When it is necessary to use an item of fire fighting equipment, such use shall be immediately reported to your shift manager. Do not go to the scene of a fire unless you have direct responsibility there.

P. The speed limit on plant streets is 9.5 miles per hour or as posted or in drawing SKDJB. There is specified speed limits for slag haul units operating on haul roads.

Q. No unauthorized person should ever start or shutdown a piece of equipment without first having received permission from the shift manager of that department in which work is being done.

R. Proper tools are to be used when performing any job. All tools used are to be in safe condition. Defective tools are to be tagged, marked "defective" and returned to an appropriate location.

S. Restroom facilities are provided throughout the plant and they are to be used without exception.

ATTACHMENT G-2

PHOSPHORUS MINIMUM MANDATORY STANDARDS

	SAFETY POLICY	SAF-GEN-829
	PHOSPHORUS MINIMUM MANDATORY STANDARDS	Issue Date 05/05/95 Supersedes Date 5/20/91
Pocatello, Idaho		Page 1 of 8
Prepared by: Dan Lyon	Approved by:	

PURPOSE:

The Phosphorus Minimum Mandatory Standards (P_4MMS) set the base level standards and establish consistency throughout the Group when working with or around elemental phosphorus. P_4 MMS are not intended to restrict or limit each plant from developing more stringent standards as appropriate to their particular process.

SCOPE:

These standards apply to all CPG locations producing, consuming or otherwise handling elemental phosphorus.

ACCOUNTABILITY:

The safety and health of all employees is the highest priority objective for all FMC locations. Every employee is responsible for his/her own safety and that of his fellow employee. He/she must know and follow all safety rules and procedures which apply to the plant, the area and the tasks he/she performs. Responsibility for personal safety goes beyond following established safety rules. Each employee must think through each task before doing them and establish additional safety procedures specific to the circumstances.

Supervision and management are responsible for overall safety performance and for training employees both in established safety rules and procedures and for establishing high standards which reinforce these principles.

I. **POLICY:**

A. **Personal Protective Equipment:**

Personal protective equipment (PPE) is intended to protect employees from phosphorus when working in an area of high potential exposure or when performing tasks which have significant potential for phosphorus exposure. PPE must be in good physical condition and must be worn as designed in order to be effective. PPE provides protection from direct contact with phosphorus for a limited time (10 to 20 seconds). Therefore, it is imperative that a source of water is available in the immediate area. Acceptable water sources include safety tub, safety shower, or a charged water hose.

1. Approved aluminized short coat and pants (or aluminized bib overalls and coat). Approved aluminized gear is Steel Grip AGL1136-30CAA and AGL8440G Aluminized Glass or Aluminized Carbon Kevlar. Aluminum gear must overlap at least 6" on coat and pants and pants must be worn over the boots with at least 4" overlap. Pants should not be so long as to drag on the ground.

2. Safety hard hat (hood optional)

3. Polycarbonate full face shield (hood optional)

4. Safety glasses (or chemical goggles)

5. Loose fitting gauntlet type (4" minimum skirt) gloves of rubber or leather construction. They should be loose fitting so they can be slung off. Short wrist length gloves are not permitted nor are leather gloves with cloth back. Gloves of longer skirt length may be used where the application is appropriate.

6. Rubber or non-porous treated leather boots extending above the ankle. The objective is to prevent phosphorus from entering the boot.

B. **Line Breaking and/or Entering Phosphorus Equipment:**
All phosphorus and phosphorus related equipment in phosphorus processing areas will be considered as phosphorus lines when maintenance and/or entering is required. Phosphorus equipment shall include but not be limited to:

* Phossy water lines
* P_4 jacket water
* P_4 burners
* Slurry lines (Pocatello)
* P_4 lines
* Acid furnace vessels
* Steam lines
* Centrifuge Product Lines:
  Steam Trace Heating Lines (Pocatello)
  Inert gas connections to furnace feed chutes and electrode seals (Pocatello)
  Furnace PRV's (Pocatello)
  Acid lines between P_4 furnace and storage tanks
  Acid tanks
* Condensate return lines
* CO lines
  CO_2, nitrogen, natural gas, inert gas air connections to P_4 vessels or lines
* P_4 cars/container (non-routine)
  Water supply lines that connect to P_4 or phossy water lines
  All equipment downstream of P_4 furnaces (Pocatello)
  P_4 spill containment systems
  Chlorine supply to reactor
  Tasks performed on the furnace platforms/roofs (Pocatello) which

use of a tapping jacket, a face shield, and a suitable water supply. These tasks include, but are not limited to: packing electrode seals, changing feed chute insulators, rodding feed chutes, rodding the off-take, and inserting blanks in the feed chutes.

*** Exceptions shall not be given under any circumstances to the "asterisked" items.**

1. Personal protective equipment, checklists, safety watch - who's only function is to provide safety protection, pre-work planning sessions, and work permits applicable to P_4 lines shall also be applicable to all equipment noted above. Exceptions to these standards will be allowed when a more detailed procedure is written to protect against the presence of P_4 in the equipment. Any line, vessel or equipment that may potentially contain phosphorus is presumed to contain phosphorus until supervision ensures that procedures are in place and qualified personnel ensure that it is free of phosphorus.

2. Appropriate personal protective equipment shall be worn until qualified personnel complete all the required reviews and sign off that all procedures have been completed, to render the equipment free from phosphorus.

3. In non-P_4 areas, the risk is considered very minimal, and these procedures are not mandatory. However, the possibility of P_4 presence during line or vessel opening shall be periodically reviewed in these non-P_4 areas.

4. When it can be determined that the possibility of phosphorus is extremely unlikely, a general procedure may be written for line opening/entering to cover these requirements.

5. Whenever practical, backflow prevention devices should be installed on utility and process lines going to the P_4 areas.

C. <u>Training:</u>

Each plant location shall develop a training program (including an annual audit system) for those tasks associated with elemental phosphorus handling. All operations, maintenance and other impacted personnel will receive initial training and subsequent annual refresher training.

1. Training programs at a minimum shall include a plan, a standard of acceptable performance, a record keeping system to document qualifications and plans for refresher training.

2. Personnel are forecast (budgeted) to conduct and receive the training. Instructors should be selected on previously developed criteria to ensure excellence.

D. <u>Engineering Standards:</u>
Materials of construction, equipment selection, fabrications, and testing of phosphorus process piping and processing equipment shall meet individual plant Engineering Standard specifications. These specifications will be reviewed as appropriate for applicability and consistency during subsequent P_4MMS reviews.

E. <u>Drills:</u>

1. Each plant shall have a minimum of four simulated phosphorus emergency drills per year. These should include the use of equipment to contain the emergency and should cover both day shift and back shifts and should occur on each unit to maximize response exposure. Newly assigned personnel will be trained on drills before assuming full job responsibility.

2. A complete emergency plan incorporating adequate alarm and communication systems shall be in place.

F. <u>Marking of Dangerous Areas (permanent and temporary):</u>
Each plant must clearly identify those areas which are hazardous and require P_4MMS protective clothing and entry restrictions. The areas are to be clearly marked (as hazardous phosphorus areas which require minimum protective clothing) and entry restricted to authorized personnel only.

G. <u>Identification of Phosphorus Lines:</u>
All lines containing phosphorus, slurry, or phossy water are to be permanently identified according to individual plant standards and applicable regulatory requirements.

H. <u>Flange and Pump Seal Covers, Flange Gaskets:</u>

1. Flange covers - All lines used specifically for handling elemental phosphorus and slurry are to have effective flange covers. Flange

covers for lines carrying phossy water will be used in high exposure/risk areas as determined by each plant.

2. Flange gaskets - Individual plants shall follow their respective Engineering Standards for appropriate flange gasket application. For reference: Pocatello Engineering Standards specify Lamons style WR, chlorocarb spiral wound gaskets with 316L centering ring meeting AP 601 for all phosphorus, centrifuge product, sludge, slurry, and hot phossy water lines. Garlock bluegard 3400 ring gaskets, 1/16" thick meeting ANSI B16.21 shall be used on cold phossy water line flanges. P_4 car/container gaskets shall match original manufacturer specifications.

3. Pump seal covers - All phosphorus, phossy water and slurry pumps which have seals in exposed locations (i.e., not contained within a pit or tank) are to have effective covers.

I. **Phosphorus Loading/Unloading:**

1. The P_4 loading/unloading area shall be clearly defined and be restricted to authorized personnel only.

2. Personal protective equipment must be worn in the area at all times during the heating, loading, and unloading process.

3. Safety tubs and a water deluge system must be in place, properly maintained and tested on a routine basis.

4. Two means of egress from the P_4 cars are required with a safety tub at each egress.

5. A safety watch with a charged water supply must be present when anyone is on top of a phosphorus car operating valves, connecting or disconnecting lines. Alternatively, in lieu of a safety observer, an observation system may be used which must include: remote video monitoring, remote operated deluge system, remote audio communications, and remote alarm activation with a rescue plan. The remote systems must be staffed during any valve operation or line breaking activity on the top of a P_4 car. This alternative may only be used for a closed loop unloading system under normal operating conditions. (Unplugging or burning open a P_4 standpipe requires adherence to Standard 11).

6. The heating cycle of the car must be controlled according to individual plant standard procedure. The procedure must address the potential of overheating a car which can cause expansion of the phosphorus into the valving and piping on top of the car.

7. The water overflow gooseneck must be directed away from the work area.

8. No instrument should be forced into a P_4 car, but must drop on its own. If forcibly removing that instrument ever becomes necessary, a deflector must be available to protect the operator.

9. Any unusual problems must be reported to supervision before additional work is done on the car.

10. Applicable DOT Regulations will be followed for loading and unloading P_4 cars.

11. Plants which load and/or unload Phosphorus shall develop a loading/unloading system with procedures which meet the following criteria:
    a) Manages the potential hazards of phosphine accumulation and exposure to personnel and equipment during the heating and loading/unloading process.
    b) Eliminates phossy water spillage from the top of P_4 cars during the loading/unloading process.
    c) Requires backflushing of the phosphorus standpipe prior to disconnecting the line from the car. These must be positive indication that the backflush has occurred.

J. <u>Safety Showers and Tubs:</u>

1. An effective safety shower and safety tub or deluge system shall be provided in phosphorus handling areas and at potential exposure sites.

2. Safety tubs will be provided at the burner level and at phosphorus loading/unloading areas.

3. Alarms will be provided for tubs and showers in remote areas unless an approved alternate procedure for communications is used.

K. **Phosphorus Line Unplugging:**

and/or sludge prior to opening it. If a line plugged with phosphorus does have to be opened, the following minimum standards apply when trying to free the plugged section:

1. A documented pre-planning session with appropriate operators, mechanics and supervisory personnel must be held for the unplugging of any line plugged with P_4, except for routine jobs where a detailed procedure exists (such as P_4 dip tubes at the Lawrence P_2S_5 plant).

2. All standard phosphorus protective equipment is to be used during the unplugging work.

3. The area around the unplugging work is to be isolated with barricade tape with appropriate tags and/or warning signs in place.

4. Standby personnel shall be available with charged water hose with pressure and flow adequate for the exposure.

5. The job is to be arranged so that the cleared P_4 can be safely controlled when it leaves the line

L. **Line Purge Procedures:**

Each plant will have a phosphorus line purge procedure and checklist or Hazardous Work Permit which verifies the line is open and depressurized.

Utility Lines Connected to Phosphorus Lines:

1. No line which ties into a P_4, slurry, phossy water or jacket water line will be broken open while under pressure.

2. Whenever practical, backflow prevention devices shall be installed on utility and process lines which tie into P_4, slurry, phossy water, and jacket water lines.

3. Each location must have a procedure for proper use, inspection and replacement of back flow prevention devices.

4. All utility lines connected to phosphorus lines shall be treated as a P_4 containing line regardless of back flow prevention device applications.

M. **Inspection of Phosphorus Lines:**

1. All plants must have an inspection and testing program for phosphorus lines to verify structural integrity.

2. Special emphasis is to be given to elbows and tees.

N. **Communications:**

1. All OSHA or MSHA recordable phosphorus burns with initial investigation results must be reported to the Manufacturing Director and the CPG Corporate Safety Manager. In addition, near misses with the potential to have caused a P_4 burn as well as injuries resulting in actual burns should be communicated to the appropriate internal and external P_4 consumers and users in a timely manner. In accordance with plant policy, the above occurrences must also initiate the near miss or accident investigation process.

2. Effective communications will be established between plants handling phosphorus. Communications include:
   a) Phosphorus burns will be reviewed as appropriate by plant personnel during the annual PERT conference.
   b) Additions or improvements necessary in the Minimum Mandatory Phosphorus Standards.
   c) Significant plant incidences.
   d) Operating and maintenance safety improvements (including piloting studies).
   e) Changes in safety procedures (manuals).
   f) Design engineering criteria.
   g) Advances in state of the art technology
   h) Revisions in phosphorus handling procedures.
3. In-plant communications shall be established to disseminate necessary information to affected employees.

4. The minimum phosphorus safety standards must be reviewed at least every two years or more frequently as required.

Appendix H

APPENDIX H

ESTIMATION OF PERCOLATION RATES THROUGH THE PHASE IV PONDS PROPOSED CLOSURE CAP DESIGN

Table of Contents

FIGURES

TABLES

Estimation of Percolation Rates Through the Phase IV Ponds Proposed Closure Cap Design

1. Introduction

A modified RCRA cap is proposed in lieu of the EPA-recommended guidance cap (or RCRA-guidance cap) for the closure of the Phase IV ponds at the FMC facility in Pocatello, Idaho. This Appendix describes the numerical model developed to evaluate the hydrologic performance of the proposed cap and to demonstrate its equivalency with the RCRA-guidance cap shown in Figure H-1.

The hydrologic performance of the proposed cap and RCRA guidance cap was evaluated using the HELP computer program Version 3 (EPA 1994a,b) and the UNSAT-H computer program Version 2.03 (Fayer and Jones, 1990). The HELP model is recommended by EPA to evaluate the hydrologic performance of surface barrier designs. However, the HELP model has major limitations in its applicability to the proposed closure cap. To overcome these limitations, the HELP and UNSAT-H programs were used in conjunction to evaluate the performance of the proposed cap.

This Appendix is organized as follows. Section 2 presents a description of the proposed cap. Section 3 describes the approach and computer codes used to evaluate the performance of the cap, and the rationale behind this approach. Section 4 presents a detailed description of the input parameters and assumptions used in the different models. Section 5 discusses the modeling results. Section 6 concludes with a brief summary of this modeling effort and Section 7 presents a list of references.

2. Description of the Proposed Cap

The proposed closure cap for the Phase IV ponds at the FMC facility in Pocatello, Idaho was designed to meet the following requirements:

1. Design the cap for a minimum functional life of 500 years.
2. Provide long-term minimization of migration of liquids through the cap.
3. Minimize the potential of biointrusion through the cap
4. Promote drainage and minimize erosion or abrasion of the cover.

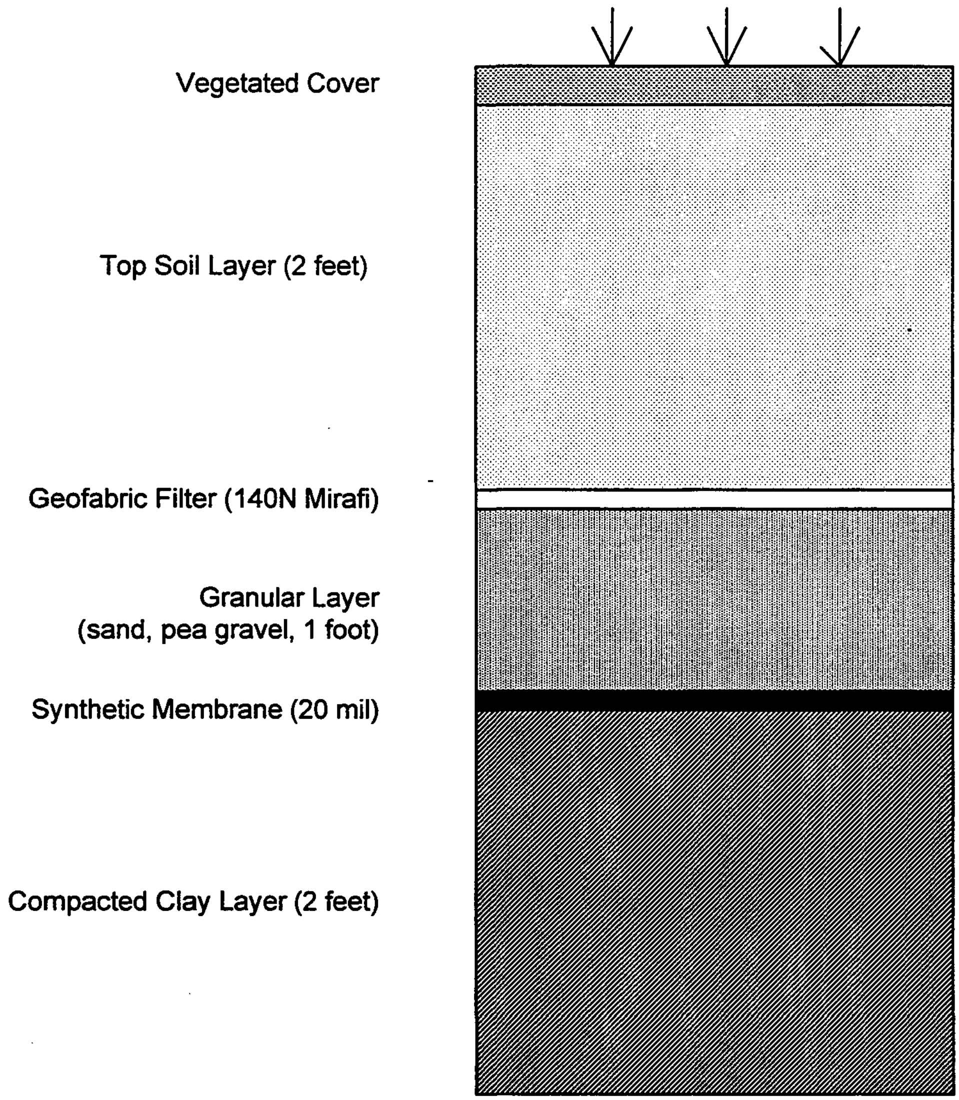


Figure H-1
RCRA Guidance Cap

5. Provide for drainage monitoring to check water balance at any time to evaluate the potential for leaks through the cap.

To meet the above requirements, the proposed closure cap will consist of the following layers from top to bottom:

- Topsoil consisting of 12 inches of native topsoil with 15% by weight pea gravel admixture, underlain by 30 inches of native topsoil without pea gravel. These two layers serve several important purposes including:

    a. provide a storage medium for the retention of infiltrating water and its subsequent removal by evapotranspiration, and

    b. allow for the natural growth of a vegetative cover which will enhance the removal of moisture from the soil and decrease wind and water erosion.

  The upper 12 inches include 15% by weight pea gravel which will serve to stabilize the cap surface and hence reduce erosion losses. The 15 % by weight proportion is based on wind tunnel tests conducted for the Hanford site in the State of Washington (Ligotke, 1993).

- Graded filter material consisting of 6 inches of coarse sand and 6 inches of 4" minus graded crushed and screened slag. This two-layer graded filter will prevent the overlying fine-textured soil from moving downward and accumulating in the coarse slag layer and/or the geofabric above the lateral drainage layer. This will assure the continued functionality of the capillary barrier.

- 18 inches of crushed and screened coarse slag. The purpose of this layer is to control biointrusion and to present an obstacle to inadvertent human intrusion. The general crushed slag product produced at the site will be comprised of angular slag, well-graded material, ranging in particle size from 1-1/2 inches to a maximum size of 12 inches.

- Sand filter material consisting of 12 inches of coarse sand to be placed underneath the coarse slag biointrusion layer to protect the underlying synthetic materials.

- Drainage layer consisting of geofabric and geosynthetic drainage net (Geonet). This layer and all underlying layers will form the secondary barrier of the Phase IV ponds caps.

- Flexible membrane liner (FML), HDPE having a minimum thickness of 60-mil.

- Low Hydraulic Conductivity Layer consisting of a Geosynthetic Clay Liner (GCL) having an equivalent hydraulic conductivity to that of a 2-ft thick clay layer. The material will consist of HDPE/Bentonite composite liner or Gundseal® equivalent. The GCL is to be installed over a prepared subgrade which includes a 12 inch sand foundation layer over the slag fill.

In effect, the proposed cap consists of two main components:

1. A capillary barrier comprised of the topsoil, the graded filter material and the biointrusion layer. The purpose of the capillary barrier in semi-arid climates such as that present in Pocatello is to limit the rate of infiltration through the cap and ensure the longevity of the cap.
2. A secondary barrier underlying the capillary barrier comprised of the drainage layer and the synthetic liners. The purpose of the secondary barrier is to act as a contingency barrier that will further decrease the net infiltration into the waste area by allowing for the lateral drainage of the excess infiltration through the capillary barrier.

3. Methodology

The performance of the proposed cap and RCRA guidance cap was evaluated using the HELP computer program Version 3 (EPA 1994a,b) and the UNSAT-H computer program Version 2.03 (Fayer and Jones, 1990). The HELP model is recommended by EPA to evaluate the hydrologic performance of surface barrier designs. However, the application of the HELP model to the proposed closure cap has two major limitations. First, the HELP model assumes a time invariant evaporative zone depth which may not be a valid assumption for semi-arid climates similar to that at Pocatello. Second, the equations used in the HELP model to simulate flow in the unsaturated zone cannot accurately model flow through the capillary barrier proposed for the Phase IV ponds. On the other hand, the computer code UNSAT-H is capable of simulating flow through a barrier layer, however does not account for any lateral drainage from the cap and cannot simulate flow though the FML. To overcome the limitations of each of these two programs, the hydrological performance of the proposed cap was evaluated in two steps. In the first step, flow through the capillary barrier (top soil to the sand foundation layer underneath the biointrusion layer) was simulated with the UNSAT-H computer program. In the second step of the analysis, the HELP program was used to simulate flow through the secondary cap underneath the barrier cap (foundation sand to the GCL). In this latter step, the daily percolation through to the bottom of the capillary cap resulting from the UNSAT-H analysis was incorporated into the HELP model input.

In addition to the approach presented above, the proposed cap was also modeled in its entirety using the HELP model for comparison purposes. Furthermore, to demonstrate the equivalency of the proposed cap to the RCRA guidance cap, the RCRA guidance cap was also evaluated using the HELP model. The input parameters and model results are described in Sections 4 and 5 of this Appendix. The computer programs HELP and UNSAT-H are briefly described in the following paragraphs.

The HELP program, Versions 1, 2 and 3, was developed by the U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS for the U.S. Protection Agency (EPA). HELP is a quasi two-dimensional hydrologic model which performs water balance analyses to predict water movement through landfills and other solid waste containment facilities. The program uses empirical equations to estimate evapotranspiration, surface runoff, surface storage, snowmelt, lateral subsurface drainage, soil moisture storage, and infiltration from climatological, soil, and design specification data.

UNSAT-H Version 2.03 (Fayer and Jones, 1990) was developed at the Pacific Northwest Laboratory for assessing the water dynamics of arid, near-surface waste disposal sites. The model simulates the flow of water and heat through unsaturated multi-layer porous media. Flow of liquid water and water vapor are calculated based on the one-dimensional Richards' equation and Fick's law of diffusive vapor, respectively. UNSAT-H uses time-dependent boundary conditions at the ground surface, calculated from daily meteorological data. UNSAT-H has been used to evaluate the performance of capillary barrier systems at Hanford (Fayer et al., 1992; Olson, 1996, DOE, 1996).

4. Input Data

4.1 WEATHER DATA

Climatological data for the UNSAT-H and the HELP programs consist of daily rainfall, temperature, and solar radiation data. Because the length of the climatological data records is much shorter than the 500-year functional life of the proposed cap, daily rainfall, temperature and radiation data were synthetically generated. The routine used to generate the climatological data was developed by the USDA Agricultural Research Service (Richardson and Wright, 1984) and is described in the HELP manual (EPA, 1994a). The generating procedure is designed to preserve the dependence in time, the correlation between variables and the seasonal characteristics of the actual weather data at the specified locations.

The 500-year synthetic data were generated by estimating first the statistical rainfall distribution data at the site from rainfall data recorded at the Pocatello Municipal Airport (National Weather Service Station No. 24156) for the period 1948 to 1991. Table H-1 gives the estimated parameters *a* and *b* defining the gamma function that describes the probability distribution of daily rainfall used in the synthetic data generator in HELP. These values are estimated for each month of the year. Based on these values the daily rainfall, daily minimum and maximum temperature and daily solar radiation were generated for the 500-year period using the routines developed the USDA Agricultural Research Service (Richardson and Wright, 1984).

TABLE H-1
MEAN PRECIPITATION AND *a* AND *b* VALUES
OF THE G-FUNCTION DISTRIBUTION OF DAILY RAINFALL IN POCATELLO

	Pocatello Municipal Airport NWS Station No. 24156 (1948-1991)		
Month	**Precipitation**	***a***	***b***
Jan.	1.08	0.711	0.125
Feb.	0.87	0.771	0.109
Mar.	1.17	0.789	0.144
Apr.	1.15	0.842	0.166
May	1.31	0.646	0.216
Jun.	1.01	0.668	0.222
Jul.	0.50	0.530	0.242
Aug.	0.61	0.555	0.243
Sep.	0.72	0.703	0.215
Oct.	0.85	0.575	0.282
Nov.	1.09	0.905	0.131
Dec.	1.09	0.786	0.127

4.2 PROPERTIES OF MATERIALS USED IN PROPOSED CAP

As noted in Section 2, the proposed cap was evaluated using a two-step approach combining the UNSAT-H and HELP computer programs. The first step simulates flow through the capillary barrier using the UNSAT-H program. In the second step, the net infiltration from the capillary barrier is then used as part of the input into the HELP model comprising of the secondary barrier underneath the biointrusion layer. For comparison purposes, a HELP model was developed for the entire proposed cap as well as for the EPA RCRA guidance cap.

This section presents the input parameters and assumptions used in all 3 models described above. A list of the input parameters used in the UNSAT-H/HELP model and the HELP model for the proposed cap are listed in Table H-2. In general, these parameters were based on field data when available, or on literature value for comparable materials. Of the parameters listed in Table H-2, the thickness, porosity and saturated hydraulic conductivity parameters are common to both models, UNSAT-H and HELP. The Van Genuchten parameters n, α and residual moisture content, θ_r, are needed for the UNSAT-H model, while the field capacity and the wilting point are required in the HELP model only. In general, these latter two parameters were set equal to default HELP values found in the HELP documentation (Table 4, EPA, 1994b) for comparable materials.

Key input parameters for the analysis of the capillary barrier cap design are the hydraulic conductivity and the moisture characteristic curves of the soils used in the cap. The moisture characteristic curves provide the relative hydraulic conductivity and the matrix potential, or suction head, as a function of the degree of saturation. Different functions are used in the literature to represent these curves. In the present analysis, the moisture characteristic curves were defined using the water retention functions proposed by van Genuchten (1978), which require assumptions of the three constants, n, α, and θ_r. The values of these constants were determined from published values in the literature for comparable soils (Carsel and Parrish, 1988).

A brief discussion of the parameter values listed in Table H-2 is presented below:

Layer 1-- Top Soil: The thickness of top soil layer used in the UNSAT-H and HELP models was conservatively set to 36 inches which is the 42 inches of top soil that will be placed over the Phase IV ponds less the estimated 500-year water and wind erosion losses of 6 inches. The

TABLE H-2
PROPERTIES OF THE MATERIALS
USED FOR THE PROPOSED CAP IN THE UNSAT-H AND HELP MODELS

Layer	Thickness (in)	Saturated Conductivity (cm/s)	Porosity	Residual Moisture Content[1]	*n*[1]	*a*[1]	Field Capacity[2]	Wilting Point[2]
Top soil	36	9.35×10^{-4}	0.473	0.067	1.41	0.015	0.222	.105
Sand Transition Layer	6	0.01	.417	0.04	2.68	0.15	0.045	0.018
Crushed Slag Transition Layer	6	0.1	.397	0.03	2.68	1.0	0.032	0.013
Coarse Slag	18	1.0	.375	0.006	3.0	10.0	0.022	0.01
Foundation Layer	12	0.01	.417	0.04	2.68	0.15	0.045	0.018
Geonet	0.2	10	.85	-	-	-	.01	.005
FML	0.04	2×10^{-12}	-	-	-	-	-	-
GCL	.17	3×10^{-9}	.75	-	-	-	.747	.4

1 Parameters required for the UNSAT-H model only

2 Parameters required for the HELP model only

saturated hydraulic conductivity was set to 9.35×10^{-4} cm/s which is approximately two times the HELP default value for fine sandy loam (page 30, Table 4, EPA, 1994b). Default HELP values were also used for the porosity, field capacity, and wilting point. The Van Genuchten parameters used to define the characteristic curves of this soil material were based on published literature values for comparable soils (Carsel and Parrish, 1988). Laboratory testing conducted on the locally available soils that will be used for this layer indicate that the above parameter values are conservative.

Layer 2-- Sand Filter (Transition) Layer: Layer 2 is a transition layer consisting of 6 inches of coarse sand. The saturated hydraulic conductivity, porosity, field capacity and wilting point values used in the numerical model were set to the default HELP values for coarse sand. The Van Genuchten parameters used for this layer were set equal to the suggested values for sand (Carsel and Parrish, 1988).

Layer 3-- Gravel Filter (Crushed Slag Transition) Layer: Layer 3 is a transition layer consisting of 6 inches of 4" minus gravel or graded crushed and screened slag. In the numerical model, Layer 3 was assumed to have soil properties similar to that of gravel. Therefore, the layer's saturated hydraulic conductivity was set to 0.1 cm/s. The van Genuchten parameters were based on the values used for the engineered barrier study at the 200 Areas at Hanford, Washington (Appendix C, DOE, 1996). Default HELP values were used for the porosity, field capacity, and wilting point.

Layer 4-- Coarse Slag: Layer 4 consists of 18 inches of crushed and screened coarse slag, ranging in particle size from 1-1/2 inches to a maximum size of 12 inches. The hydraulic conductivity of this layer was assumed to be 1 cm/s, one order of magnitude greater than that of Layer 3. The van Genuchten parameters was set equal to the values used for the biointrusion layer of the engineered surface barrier at the 200 Areas at Hanford, Washington (Appendix C, DOE, 1996).

Layer 5-- Sand Filter Layer: Layer 5 consists of 12 inches of coarse sand. Its hydraulic conductivity was assumed to be identical to that of Layer 2.

Layer 6-- Geonet Drainage Layer: From the manufacturer's specifications, the thickness and transmissivity of the geonet at 10,000 psf compressive are 0.2 inches and 0.002 m^2/s, respectively. These values correspond to a saturated hydraulic conductivity of 40 cm/s. To provide some measure of conservatism, the geonet hydraulic conductivity in the HELP model was set to 10 cm/s.

Layer 7-- Flexible Membrane Liner (FML): The thickness of the FML used in the model is 40 mil which is less than the minimum of 60 mil proposed for the cap. The hydraulic conductivity of the FML was set equal to 2 x 10^{-12} cm/s, as specified in the manufacturers specifications. This value is also an order of magnitude larger than the HELP default value for HDPE. The placement quality of the FML was assumed to be good. Because the design life of the cap is quite long, the pinhole density was assumed to be "poor" on a scale ranging from "excellent" to "poor", which corresponds to 10 holes/acre.

Layer 8-- Geosynthetic Clay Liner (GCL): The hydraulic conductivity of the GCL was set equal to 3 x 10^{-9} cm/s the HELP default value for a bentonite mat. This value is also approximately equal to the average of the values reported in the manufacturer's specifications. Sensitivity analysis previously conducted indicated that the net infiltration rate is not sensitive to the GCLs hydraulic conductivity.

For comparison purposes, the infiltration through EPA's RCRA guidance cap was simulated using the HELP model. A list of the material properties used for the RCRA guidance cap are presented in Table H-3.

TABLE H-3
PROPERTIES OF THE MATERIALS
USED FOR THE RCRA GUIDANCE CAP

Layer	Thickness (in)	Saturated Conductivity (cm/s)	Porosity	Field Capacity	Wilting Point
Top soil	24	9.35 x 10^{-4}	0.473	0.222	0. 105
Sand Transition Layer	12	0.01	.417	0.045	0.018
FML	0.04	2 x 10^{-12}	-	-	-
Clay Liner	24	1 x 10^{-7}	0.43	.367	0.28

4.3 TRANSPIRATION

A key component in the cap's water budget is transpiration which is the removal of water from the soil by transpiring plants. In the UNSAT-H model, the transpiration term is calculated in three steps. First, the potential evapotranspiration is partitioned into potential evaporation and potential transpiration. The transpiration potential is then distributed over the root zone in proportion to the relative root density at each depth. As described in the closure cap, the vegetative cover will consist of a mixture of native grasses. To provide vegetation compatible with the local climatic conditions, the mixture was developed through consultation with the Agricultural Research Center, College of Forestry, University of Idaho, Moscow, ID, and the Cooperative Extension System, University of Idaho at Pocatello. The maximum depth and plant biomass used in the model are 3.5 ft and 440 g/m^2, respectively. Fifty percent (50 %) of the cap's surface is assumed to be bare of plants. All these values are consistent with the proposed vegetation mixture. Finally, the actual transpiration as a function of depth and time is computed from the potential evapotranspiration and the soil's moisture content.

In the HELP model, the top soil was conservatively assumed to maintain a vegetative cover with a leaf area index, LAI =1, which corresponds to a "poor stand of grass. The evapotranspiration zone depth was assumed to be 24 inches which is consistent with the default HELP for the area of Pocatello.

4.4 ADDITIONAL ASSUMPTIONS

In addition to the input parameters and assumptions discussed in the Sections 4.1 through 4.3, the UNSAT-H model includes the following assumptions:

- No surface runoff is generated. This is a very conservative assumption because net infiltration will primarily be a result of extreme rainfall events. However, a significant portion of the precipitation falling during these events may develop into surface runoff.
- The capillary barrier is assumed to generate no lateral drainage. This means that any water that does not evaporate or is not taken by the plants will infiltrate through the cap.
- To minimize the impact of the assumed initial moisture distribution in the simulated soil column all simulations were run for 600 years, out of which the last 500 years were used to estimate the average percolation through the cap. The effect of the assumed initial conditions is negligible after the first 100 years of simulation.

The following additional assumptions were incorporated in the HELP models for both the proposed and guidance caps:

- To maximize percolation rates, no surface runoff was allowed.
- Initial conditions were set to steady state conditions, as estimated by the HELP program.
- The drainage length of the cap was conservatively set to 400 ft.

5. Model Results

The hydrologic performance of the proposed closure cap was evaluated based on the input data and assumptions described in the previous section. Figure H-2 shows the estimated annual percolation rate at the bottom of the biointrusion layer and the bottom of the GCL for the simulated 600 years of precipitation data generated using the UNSAT-H/HELP approach described in Section 2. The long-term percolation through the bottom of the biointrusion layer is 0.05 in/yr. This rate was calculated using the UNSAT-H model for the capillary barrier. The long term average percolation through the bottom of the GCL, estimated with the HELP model for the secondary cap underneath the biointrusion barrier and based on the last 500 years of this simulation, is 8×10^{-6} in/yr. Figure H-2 also shows that the maximum annual percolation through the bottom of the GCL is consistently less than 10^{-4} in/yr.

The performance of the proposed cap as well as the EPA RCRA guidance cap were also evaluated with the HELP model. A summary of all the of the different modeling simulations is presented in Table H-4. These results show that for both of the modeling approaches, the net annual percolation through the proposed cap is lower than that predicted for the RCRA guidance cap. This indicates that the performance of the proposed cap exceeds that of the RCRA guidance cap.

6. Summary

A numerical model was developed to evaluate the hydrological performance of the proposed cap and demonstrate its equivalency with the EPA's RCRA guidance cap. Two approaches were used to calculate the long-term water budget through the different layers of the proposed cap. The first approach is based on the combined application of two computer programs, UNSAT-H and HELP. The UNSAT-H program is used to simulate the movement of moisture through the capillary barrier, while the HELP program is used to simulate moisture movement through the secondary barrier underneath the capillary barrier. By combining these two computer programs, some of the limitations of each program are overcome. For comparison purposes, the proposed cap was also simulated in its entirety using the HELP program. To demonstrate the equivalency of the proposed cap to the guidance cap, the guidance cap was also modeled using the HELP program.

Based on available field data and data published in the literature for comparable materials, the water balance through the proposed and guidance caps was simulated for 500 years. The results

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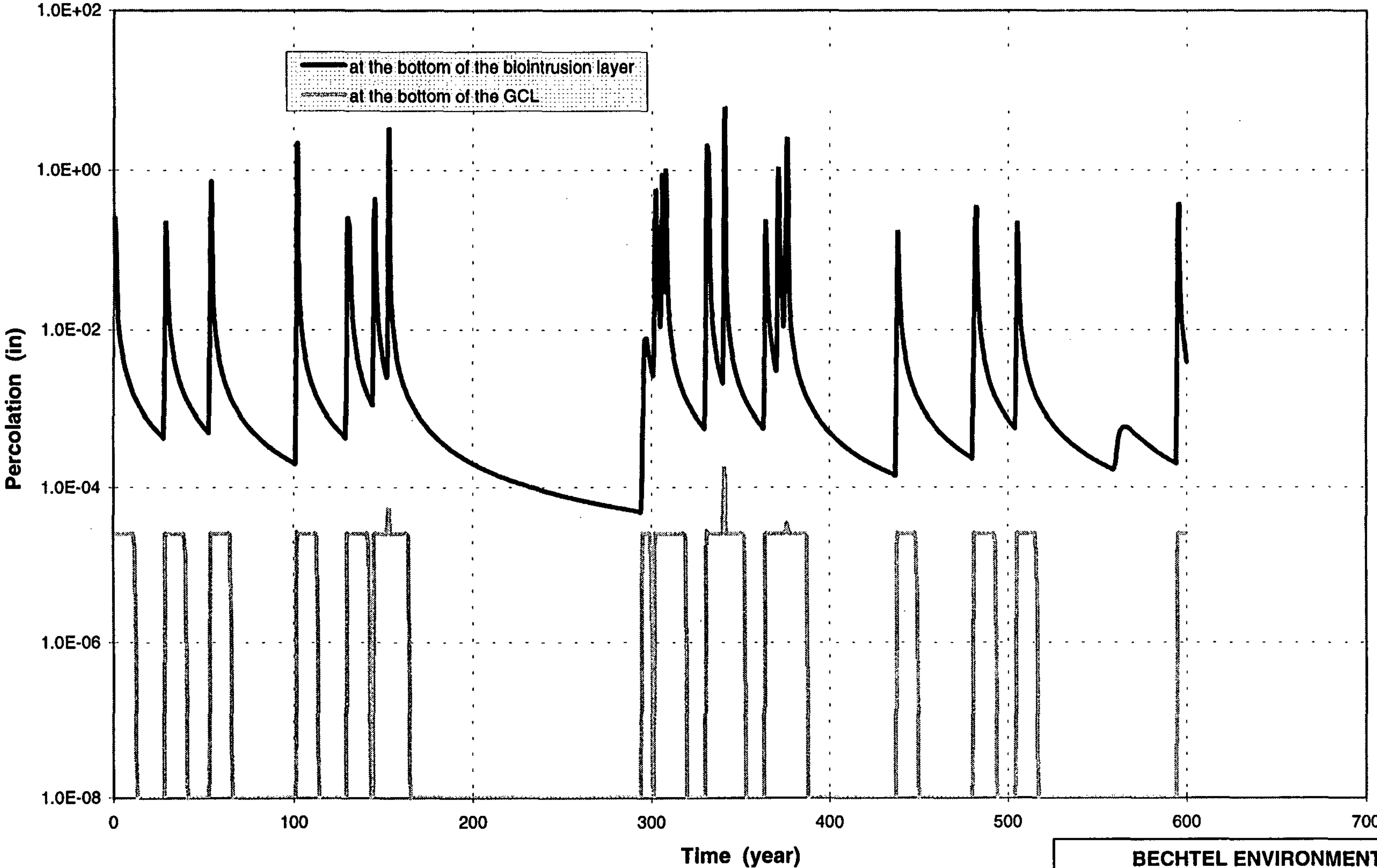

BECHTEL ENVIRONMENTAL, INC. SAN FRANCISCO		
FMC CORPORATION POCATELLO, IDAHO		
Estimated Annual Percolation Through the Proposed Cap		
Job Number	Drawing No.	Rev.
20906	Figure H-2	0

TABLE H-4
MODELING RESULTS
FOR THE PROPOSED AND GUIDANCE CAPS

Cap	Modeling Approach	Runoff (in/yr)	Evapotranspiration (in/yr)	Lateral Drainage (in/yr)	Percolation (in/yr)
Proposed Cap[1]	UNSAT-H/HELP	-	11.62	0.05	$8x\ 10^{-6}$
	HELP	-	6.98	4.69	2×10^{-5}
RCRA Guidance Cap[2]	HELP	-	11.23	.17	11×10^{-5}

[1] Simulated for 500 years

[2] Simulated for 44 years

of this modeling effort indicate that the net infiltration through the proposed cap is negligible (on the order of 10^{-5} to 10^{-6} in/yr). Furthermore, the performance of the proposed cap is expected to exceed the performance of the RCRA guidance cap.

7. List of References

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APPENDIX H-1

PROPOSED CAP HELP VERSION 3 SIMULATIONS

ATTACHMENT H-1

This attachment provides a list of the input and output files used in the UNSAT-H and HELP models described in Appendix H. All of the input/output files listed below are included in the attached computer diskettes at the end of this attachment.

HELP Model for Proposed Cap (8 Layers)

Because each HELP model (Version 3.03) is limited to 100 years, the long term performance of the cap was simulated by running five consecutive 100-years simulations. The moisture content at the end of each simulation was used as initial conditions in the following simulation. The input/output files are:

- Soil Properties and Initial Conditions (6 files, one for each 100 years of simulation)
  SOIL1.D10, SOIL2.D10, ... SOIL6.D10
- Precipitation (6 files, one for each 100 years of simulation)
  RAIN1.D4, RAIN2.D4, ... RAIN6.D4
- Temperature (6 files, one for each 100 years of simulation)
  TEMP1.D7, TEMP2.D7, ... TEMP6.D7
- Solar Radiation (6 files, one for each 100 years of simulation)
  RAD1.D13, RAD2.D13, ... RAD6.D13
- Evapotranspiration(1 file for 600 years of simulation)
  POCATEL.D11
- Output (6 files, one for each 100 years of simulation)
  Y100.OUT, Y200.OUT, ... Y600.OUT

HELP Model for EPA RCRA Guidance Cap

The RCRA Guidance cap was evaluated using the HELP model based on 44 years of recorded data between 1948 and 1991. The input/output files are:

- Soil Properties:
  RCRA.D10
- Precipitation (1 file for 44 years)
  POCATEL.D4
- Temperature (1 file for 44 years)
  POCATEL.D7
- Solar Radiation (1 file for 44 years)
  POCATEL.D13
- Evapotranspiration (1 file for 44 years)
  POCATEL.D11

- Output (1 file for 44 years)

  RCRA.OUT

UNSAT-H/HELP Model for the Proposed Cap

The proposed cap was also evaluated using a combined UNSAT-H/HELP model. The UNSAT-H was used to model moisture movement through the capillary barrier; the HELP model was used to model moisture through the secondary barrier underneath the biointrusion layer. The input/output files for the UNSAT-H model are

- Parameter input files (total of 600 files, one file for each year of simulation):

  Y001.INP, Y002.INP, ..., Y600.INP

- Input weather data files (total of 600 files, one file for each year of simulation):

  Y001.WEA, Y002.WEA, ..., Y600.WEA

  Files include daily precipitation, maximum and minimum temperatures, solar radiation, cloud cover, wind speed, etc.

- Output (total 600 files, one file for each year of simulation):

  Y001.INF, Y002.INF, ..., Y600.INF

  Files include computed daily fluxes at different depths for 600 years of simulation

The input/output files for the HELP model (4 layers) are:

- Soil Properties and Initial Conditions (6 files, one for each 100 years of simulation)

  SOIL1S.D10, SOIL2S.D10, ... SOIL6S.D10

- Precipitation (6 files, one for each 100 years of simulation- from UNSAT-H model)

  INF1.D4, INF2.D4, ... INF6.D4

- Temperature (average temperature from 44 years of record)

  TEMP.D7

- Solar Radiation (modified to reflect conditions below the biointrusion layer)

  RAD.D13

- Evapotranspiration (modified to reflect conditions below the biointrusion layer))

  EVAP.D11

- Output (6 files, one for each 100 years of simulation)

  Y1001S.OUT, Y200S.OUT, ... Y600S.OUT

- Summary (yearly output from the UNSAT-H and HELP models)

  SUMMARY.XLS

Computer Files Included in Attached CD

Folder 1: HELP Model:

- PKZIP.EXE, PKUNZIP.EXE: compression utility
- 8LAYERS.ZIP: HELP model input/output files for the proposed cap

  SOIL1.D10, SOIL2.D10, ... SOIL6.D10
  RAIN1.D4, RAIN2.D4, ... RAIN6.D4
  TEMP1.D7, TEMP2.D7, ... TEMP6.D7
  RAD1.D13, RAD2.D13, ... RAD6.D13
  POCATEL.D11
  Y100.OUT, Y200.OUT, ... Y600.OUT

  To unzip type PKUNZIP 8LAYERS.ZIP

- RCRA.ZIP: HELP model input/output files for the EPA RCRA Guidance cap

  RCRA.D10
  POCATEL.D4
  POCATEL.D7
  POCATEL.D13
  POCATEL.D11

  To unzip type PKUNZIP RCRA.ZIP

Folder 2: Yr 1-150:

- WEA1.ZIP: Weather input used in the UNSAT-H model for years 1 to 150.

  Y001.WEA, Y002.WEA, ..., Y150.WEA

  To unzip type PKUNZIP WEA1.ZIP

- INP1.ZIP: Input parameters used in the UNSAT-H model for years 1 to 150.

  Y001.INP, Y002.INP, ..., Y150.INP

  To unzip type PKUNZIP INP1.ZIP

Folder 3: Yr 151-300:

- WEA2.ZIP: Weather input used in the UNSAT-H model for years 151 to 300.

  Y151.WEA, Y152.WEA, ..., Y300.WEA

  To unzip type PKUNZIP WEA2.ZIP

- `INP2.ZIP`: Input parameters used in the UNSAT-H model for years 151 to 300.

  `Y151.INP, Y152.INP, ..., Y300.INP`

  To unzip type `PKUNZIP INP2.ZIP`

Folder 4: Yr 301-450:

- `WEA3.ZIP`: Weather input used in the UNSAT-H model for years 301 to 450.

  `Y301.WEA, Y302.WEA, ..., Y450.WEA`

  To unzip type `PKUNZIP WEA3.ZIP`

- `INP3.ZIP`: Input parameters used in the UNSAT-H model for years 301 to 450.

  `Y301.INP, Y302.INP, ..., Y450.INP`

  To unzip type `PKUNZIP INP3.ZIP`

Folder 5: Yr 451-600:

- `WEA4.ZIP`: Weather input used in the UNSAT-H model for years 451 to 600.

  `Y451.WEA, Y452.WEA, ..., Y600.WEA`

  To unzip type `PKUNZIP WEA4.ZIP`

- `INP4.ZIP`: Input parameters used in the UNSAT-H model for years 451 to 600.

  `Y451.INP, Y452.INP, ..., Y600.INP`

  To unzip type `PKUNZIP INP4.ZIP`

Folder 6: Yr 1-150:

- `INF1.ZIP`: Output file from UNSAT-H model for years 1 to 150.

  `Y001.INF, Y002.INF, ..., Y150.INF`

  To unzip type `PKUNZIP INF1.ZIP`

Folder 7: Yr 151-300:

- `INF2.ZIP`: Output file from UNSAT-H model for years 151 to 300.

  `Y151.INF, Y152.INF, ..., Y300.INF`

  To unzip type `PKUNZIP INF2.ZIP`

Folder 8: Yr 301-450:

- `INF3.ZIP`: Output file from UNSAT-H model for years 301 to 450.

  `Y301.INF, Y302.INF, ..., Y450.INF`

  To unzip type `PKUNZIP INF3.ZIP`

Folder 9: Yr 451-600:

- `INF4.ZIP`: Output file from UNSAT-H model for years 451 to 600.

  `Y451.INF, Y452.INF, ..., Y6050.INF`

  To unzip type `PKUNZIP INF4.ZIP`

Folder 10: Summary:

- `4LAYERS.ZIP`: HELP model input/output files for the lower four layers.

  `SOIL1S.D10, SOIL2S.D10, ... SOIL6S.D10`
  `INF1.D4, INF2.D4, ... INF6.D4`
  `TEMP.D7`
  `RAD.D13`
  `EVAP.D11`
  `Y1001S.OUT, Y200S.OUT, ... Y600S.OUT`

  To unzip type `PKUNZIP 4LAYERS.ZIP`

- `SUMMARY.ZIP`: EXCEL file with annual percolation at the bottom of the biointrusion layer (from UNSAT-H model) and at the bottom of the GCL (from the four-layer HELP model)

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